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ON THE ROOF OF THE WORLD: FILMING THE ASSAULT ON MOUNT EVEREST.—[See page 100]

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With the Editors

CONTENTS

AUGUST, 1924

LEADING ARTICLES

SHORTER ARTICLES

DEPARTMENTS

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WHEN, a year ago, we commenced our investigation of the electronic reactions upon which is based the Abrams system of diagnosis, we regarded the matter as one which could be cleared up in a very short time. Indeed, had we supposed otherwise, we should not at that moment have undertaken it. We were then, as we are still, engaged in a psychical research which by its very nature must obviously be strung out over a very long period; and we would not voluntarily have got ourselves involved in two such long-winded enterprises at the same time. The claims advanced for the electronic system of diagnosis were so positive, and the precision of result attributed to it was so extraordinary, as to make it seem inevitable that it would be susceptible of a very rapid proof or disproof. In this we were deceived; what we had visualized almost in terms of mathematical analysis with an almost immediate verdict, resolved itself into a long and arduous pursuit.

FOR this, and the resultant long-drawn out character of the series of articles reporting our work in the electronic field, the responsibility lies not with us, but with the electronists. The instant that our intent became clear of subjecting their technique to an examination under which it would be necessary for them to make good, these practitioners were struck with panic. Instead of meeting us, they began a long process, first of stalling, second of retreating to previously prepared positions. Under the guise of cooperation, they engaged in a wordy campaign of correspondence and argument, with the one aim of avoiding anything in the form of an actual test. And as, in spite of their dilatory tactics and their frantic efforts to dodge, we finally pinned them down and made it obvious that the claims which they had been putting forth in the regular course of business were contrary to fact, they would withdraw without apology from these and substitute new statements of what their technique was, what it would do, what degree of accuracy it would score, and what conditions it required for its operation.

PARTICULARLY flagrant has been the unwillingness of the electronic fraternity to be judged under any procedure remotely resembling that which they have been using as a matter of ordinary routine in telling their patients that they had, or had not, various major ailments like cancer and tuberculosis and syphilis. But the end is now in sight. Each fresh retreat has made it more abundantly clear that in the nature of the case no position taken up by electronic medicine is tenable, however carefully prepared. Our June and July reports in these columns, taken in connection with what preceded them, must have been sufficient to make every thinking reader realize that our investigation was approaching a conclusion, and one unfavorable to the disciples of Abrams. This month's article carries the matter a little further; next month's will bring it to its climax, giving space to the final report of our Committee that has been in charge of this investigation. In view of the nature of what has gone before, we will be giving nothing away when we predict that this report will be not merely unfavorable, but will actually carry a categorical denial that the "electronic reactions" upon which the whole Abrams structure rests have any objective existence.

THIS will bring "Our Abrams Investigation" to what we regard as a highly successful end. We went into it hoping that we might be able to give our endorsement to the electronic system, hoping that we might find it to be a major development of twentieth century science, fully prepared for the necessity of heralding it to the world as such. When we find that the facts lead us merely to an exposure of the greatest single piece of organized quackery in the history of medicine, however, we feel that our service to the community in so reporting is as large as though the outcome had been that which, *a priori*, was the more to be desired.

THE wonderfully successful flights of the "Shenandoah" which we have noticed in the past, the forthcoming flight across the Atlantic by the "ZR-III" to which we give space in the present issue, the tragic end of the French "Dixmude"—all this has aroused great interest and conflict of opinion with regard to the possibilities of the giant rigid dirigible. Dispassionate answer must be given to the question "Are airships safe and practical?" before these craft can be seriously considered for commercial transportation. Professor Alexander Klemin of New York University, who is known to our readers through his contributions in the aeronautical field, has put in our hands a series of three articles in which this whole problem is carefully analyzed, its components isolated and discussed, and a conclusion reached. Professor Klemin deals with the safety of the airship while in the air, the problems of landing and mooring and housing, the structural elements of airship design in their bearings upon all this, the hydrogen-helium issue from the angle of fire prevention and again from that of gas losses and gas supply, the item of maintenance, that of propulsive economy—in a word, he gives the whole subject the careful treatment which we would expect from him. His conclusions?—ah, we don't tell on this page *everything* we know. We have exposed our hand on the Abrams matter; we shall let you wait for a sight of Professor Klemin's hand until he shows it to you himself. This series will start in a very early issue—probably that of September—and will run along to as early a climax as the demands of more general features upon our space permit.

IT is extraordinary that just as we go to press with a cover showing the explorers on Mt. Everest, that two members of the expedition should have been killed in an attempt to conquer that loftiest of mountains. They were overwhelmed by a Monsoon. This has resulted in the expedition being called off for the year. It is, of course, problematical whether another expedition will be attempted. George Leigh Mallory and A. C. Irvine were the members of the Mt. Everest expedition whose deaths in the attempt are now announced. Both were distinguished mountaineers.

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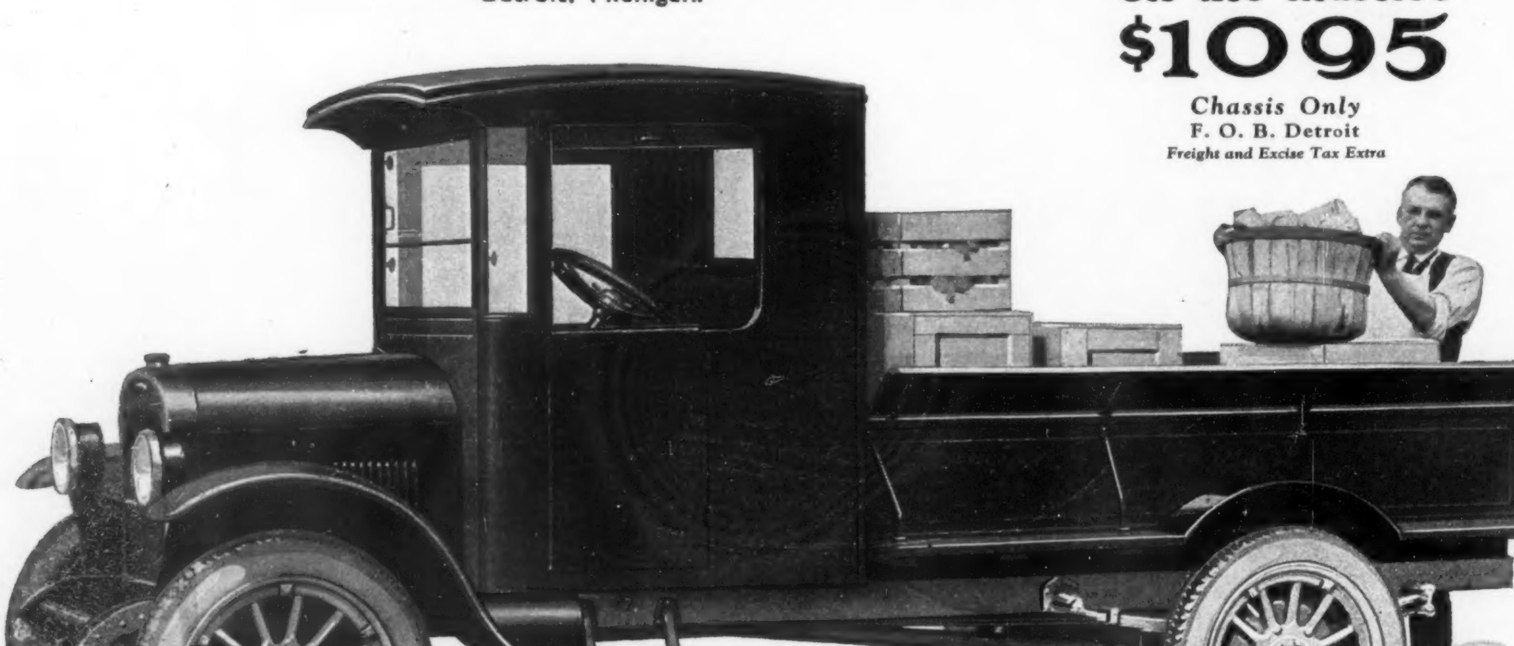

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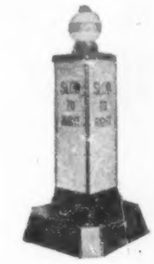
EIGHTIETH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, AUGUST, 1924



On the Road

Suggestions for Lightening the Motor Tourist's Contact With the Traffic Problem and Other Puzzles

By J. Malcolm Bird

WITH the coming of summer, the question is, as it has always been, "Where to go?" Most of us can remember the time when consideration of this perennial problem opened with an excursion among the railroad offices, devoted to the collecting of literature. Ultimately one returned to the ticket office and bought one of those extraordinary yard-long tickets that opened and shut like an accordeon. Culmination came in a wild last-minute struggle with trunks that wouldn't shut and expressmen who wouldn't wait, hackmen and porters—the specter of the clock always in the background, remorselessly ticking away the precious minutes that intervened before the departure of the train.

The question "Where to go?" is still with us, but the atmosphere surrounding its consideration is changed. In place of the railroad's superadjectivial literature we have the studied, tabular conciseness of the Blue Book. That thing on the table that looks like the telescopic railroad ticket of bygone years is in fact a road map. The problem of baggage is still with us. But we don't have to wrestle with recalcitrant trunks at the last minute, because there isn't any last minute; and we are supremely indifferent to hackmen and porters. For we provide our own transportation; and, in gay emancipation from the printed schedule, if we are not ready at 9:05 we delay our start until 9:20, or 11:10, or any intermediate hour that suits our convenience.

If we have dismissed the going-away problems of 1900, however, we have introduced new ones in their place. And in 1900 we did all our struggling beforehand; after we got on the train everything was up to the conductor. But today we carry our problems on the road with us, and get clear of them only when we get safely home again. The difference between a successful tour and an unsuccessful one lies almost entirely in the degree to which we have anticipated their cropping out and provided in advance for their solution.

The people who take to the road fall sharply into two groups. The members of one are tourists in every sense—they are living in their cars for a period, staying in one place only long enough to see what is to be seen, then moving on. The other group consists of people who are using their cars merely as a substitute for the train. A vacation spot has been selected, and it can be reached in from one to four days of driving. So driving it is, rather than patronizing the railroad.

In spite of the gap between their intentions, the people in these groups have common problems. That of deciding where they want to go is one that I shan't cover here, save in a very general way, by laying down a few simple words of advice and caution. The burden of these is, don't bite off more than you can chew.

Of the six streets and two park driveways meeting here, three are one-way thoroughfares. All traffic passing through the intersection or turning here must join the circular stream around the space outside the car-tracks. There are numerous zones of safety, and several traffic officers. In addition to the general parking regulations prevalent throughout the city, there are special prohibitions applying here. Remembering that the congestion looks much worse from the ground than from the air, what chance do you think you would stand, driving through this junction for the first time, of avoiding trouble?

Columbus Circle—an eight-cornered intersection in the heart of New York's heaviest traffic zone

Some of us are easy drivers; some are not. Some of us are long drivers, able to stick at the wheel all day and far into the night, and like it; others must stop to stretch the legs and refresh the inner man at frequent intervals; still others are through for the day at 100 miles. The same remarks apply to passengers; and don't forget that the most durable driver may be a fearfully fragile passenger, or *vice versa*. The one thing more pathetic than a thoroughly soul-weary driver is a thoroughly car-sick passenger on a blistering hot day. Don't embark, as driver or passenger, upon a trip of more than two days without some experience behind you indicating how you will stand up under it. Don't start without a second member who *can* drive, in a pinch. And don't make up a touring party of people, half of whom get their sole pleasure from seeing the road spin out under the wheels and the odometer roll up the miles, while the others regard a tour as a matter of running ten miles and stopping half an hour to pick flowers and take pictures.

If all your party want to do the same thing and all are able to do it, it doesn't matter much whether you take this, that or the other kind of tour; and I am not going to try to prescribe for you here. But there are a few general remarks about roads and routes which ought to be made.

If you plan to drive across the territory separating the Rocky Mountains from the Pacific Coast, you doubtless know in advance that you will strike a lot of very tough driving. But I would urge the advisability of avoiding the Lincoln Highway west of Salt Lake, or any other route taking you across Utah to Nevada and California. All such routes present the severest natural obstacles of climate and geography; all of them suffer at this time from very bad road conditions which will be worse before they are better; it is even doubtful whether they will continue to be passable for the average driver. There is a route through New Mexico and Arizona, presenting better driving, no worse desert country, and an opportunity to see the Grand Canyon as well as to take in the Rockies to any desired extent in side trips before leaving Colorado. There are also routes through the northwest that are far better in climate and geography, and at their worst no more difficult for the driver, than the better-advertised ones further south—assuming,

Left: A Wisconsin road intersection, with complete indications of permanent and temporary routes. *Center:* An admirable detour sign combined with the admirable procedure of separating through and local traffic on the detours. *Right:* The very latest detour-sign technique, and one which we have noted in New Jersey as well as Wisconsin. Note the caption "you are here," as well as the complete map of detour and closed section of main road. Smaller signs will carry the stranger safely through all the junctions along the detour, but the complete information of this map starts him on the circuit with a feeling of security equalled in no other way

Some pages out of the modern detour engineer's note-book

of course, that you have more sense than to try them in the snowy season.

In no other section of the country is the difference between the best route and the second-best so serious. A very good thing to avoid is the Lincoln Highway between Pittsburgh and East Liverpool, Ohio; what part of this is not rough city streets is bad dirt road through the hills. While these conditions remain, the best way east from Chicago is via Cleveland, Buffalo and Albany; and from St. Louis, via Columbus, Wheeling and the Maryland mountains. If you have occasion to drive from New York to Boston, go through Hartford and Springfield rather than New London and Providence; and if you go into Maine, don't look for sustained good roads anywhere except along the major coast highway through Portland to Bangor.

Beyond these few items, the choice of routes is so largely a matter of temporary conditions of weather and road-work that no long-range advice is possible. As a general proposition, detours south of the Ohio and Potomac (and sometimes in the middle West as well) are so bad that when a long one exists, any route avoiding it is likely to be the best choice. If you are planning a trip that makes this remark applicable, expert local advice is your only salvation; I shall come, further on, to the question of how to get it.

On most standard routes one finds no difficulty in keeping the right road. Driving from Buffalo to New York for the first time several years back, I was wholly without literature or maps, save one of Buffalo itself. Yet I completed my journey without a single wrong turning, and with only three questions asked—two of which were due to temporary road conditions. Only once or twice did I have to stop to digest the signs and markers—they were built to be read on the fly. One can do as well over an immense number of short interstate and intra-state routes, and on numerous named and marked highways of greater length, of which the Lincoln is but the oldest and best known.

When one's itinerary leaves the marked roads, one must rely upon a judicious combination of maps, questions, and country finger-posts. The recipe works only if the ingredients are mixed in the correct proportions; also, it is necessary that the map be correct, the finger-posts legible, and the road-side informer himself properly informed.

Last summer I met an amusing attempt to drive exclusively by map. The man was touring New England, for the first time. His map extended from New York to Montreal and Halifax, all on a sheet which, completely unfolded, could be spread on one's knees. The major roads were indicated by red lines—to scale, they must have been at least 20 miles wide. Of course there could be no attempt to show more than starting and terminal points, with the larger towns en route. The victim was trying to get from Bar Harbor to Prospect Ferry—a complicated run of some 40 miles, with numerous puzzling junctions. All his map was good for was to tell him that you *could* drive from Bar Harbor to Prospect Ferry. He had been through ten days of similar distress, all over Maine, New Hampshire and Vermont; he hadn't yet discovered where the trouble lay.

There are maps whose scale is large enough and whose execution is detailed enough to show all the roads. On such a map, the line that represents your route bears a distinct physical correspondence to the road as it unfolds before your eye. Each crossing, junction or prominent turn is present and recognizable, so that you can follow the chart through each and know at all times exactly where you are. Then there are maps whose scale is not large enough for this, or whose execution is not detailed enough. Such a map is of no slightest value other than as a list of the towns through which you are to pass; and it would be more convenient to draw up such a list in tabular form, leaving at home the bulkier map with its annoying folds. There is no middle ground: the map that gives the shape of the road, you can drive by; the map that doesn't, you can't.

For clear representation of road-shapes, the best maps are those of the United States Geological Survey. You can get, free, from the Director of the Survey, index maps of any States in which you are interested, showing what sections of these States are covered by published maps. You can order these maps, by section name, at six cents apiece in quantities of 50 or more. You will get them about 10 days after you mail your order; so if you want them, write for the index maps a month before your tour starts.

These maps are large, and they come to you flat. If you fold them, you must give three folds each way to bring them to a reasonable size; and this makes them awkward to handle on the road. It is also difficult to carry them in such way that, on running off the edge of one section, you can at once pick up the adjoining section. And they make no distinction between good and poor roads—any road is a road, and that's the end of it.

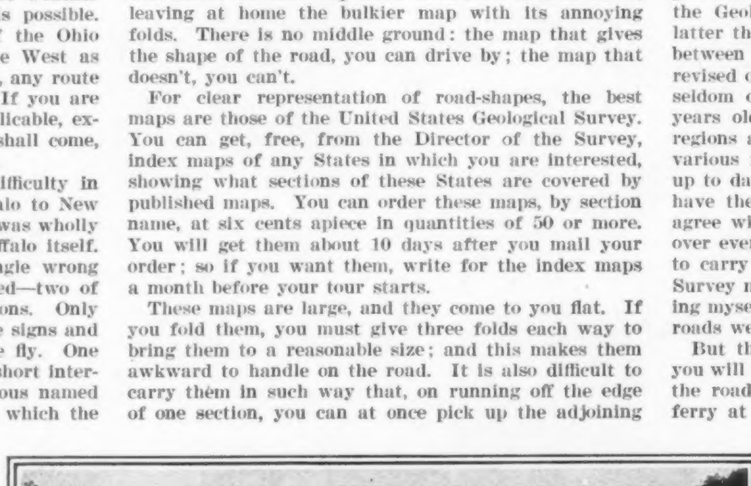
The easiest map to handle while the car is in motion is that put out by the Michelin people. Though it is a folded map, any part of it is exposed to the eye by opening the folder like a book; and the ingenious arrangement that makes this possible also prevents the wind from playing as much havoc as it does with the pages of an ordinary book. But the series is just started, and so far covers only a limited area adjoining the Atlantic seaboard. Though the scale is much smaller than the geological sheets, the drawing is so cleverly done as to give full driving instructions at all junctions where the surface of both roads is sufficiently good to leave one in any doubt.

The sectional maps in the Blue Books for the eastern part of the country are of great value. Copied from the Geological Survey, they are as complete as the latter though on a smaller scale; and they distinguish between good, fair and poor roads. But they are not revised often enough; a map making this distinction is seldom of much value when more than two or three years old. Numerous folded maps, covering counties, regions around large cities, etc., etc., are published by various firms; but they are seldom if ever any more up to date than those in the Blue Book, and the latter have the advantage that they can be hand-revised to agree with the printed text, which apparently *is* done over every year. My procedure in strange territory is to carry Blue Books and, when they exist, Geological Survey maps. I have then an infallible means of locating myself at all times; plus a means for knowing what roads were once the preferred ones.

But there come times when, in spite of everything, you will have to ask your way of people you meet along the road. Now I suppose you wouldn't drive off the ferry at Jersey City, and ask the traffic cop the way to San Francisco. But my Bar Harbor acquaintance met me under circumstances that did not reveal me as a motorist, and he asked me the way to Boston—a cold 300 miles away. And I have heard a tourist on country roads in the hills of eastern Ohio ask a farmer "which turn for Chicago?"

What you must have to avoid doing this sort of thing is something already mentioned—a list of the towns through which you expect to drive. I could multiply examples out of my own experience, all going to clinch the point that when you know the next town by name, you can always get directed to it; and when you don't, you usually are quite unable to convey to your would-be informer any idea at all of where you want to go. But the thing is so obvious, once it is pointed out, that I shall save the space which the examples would take up.

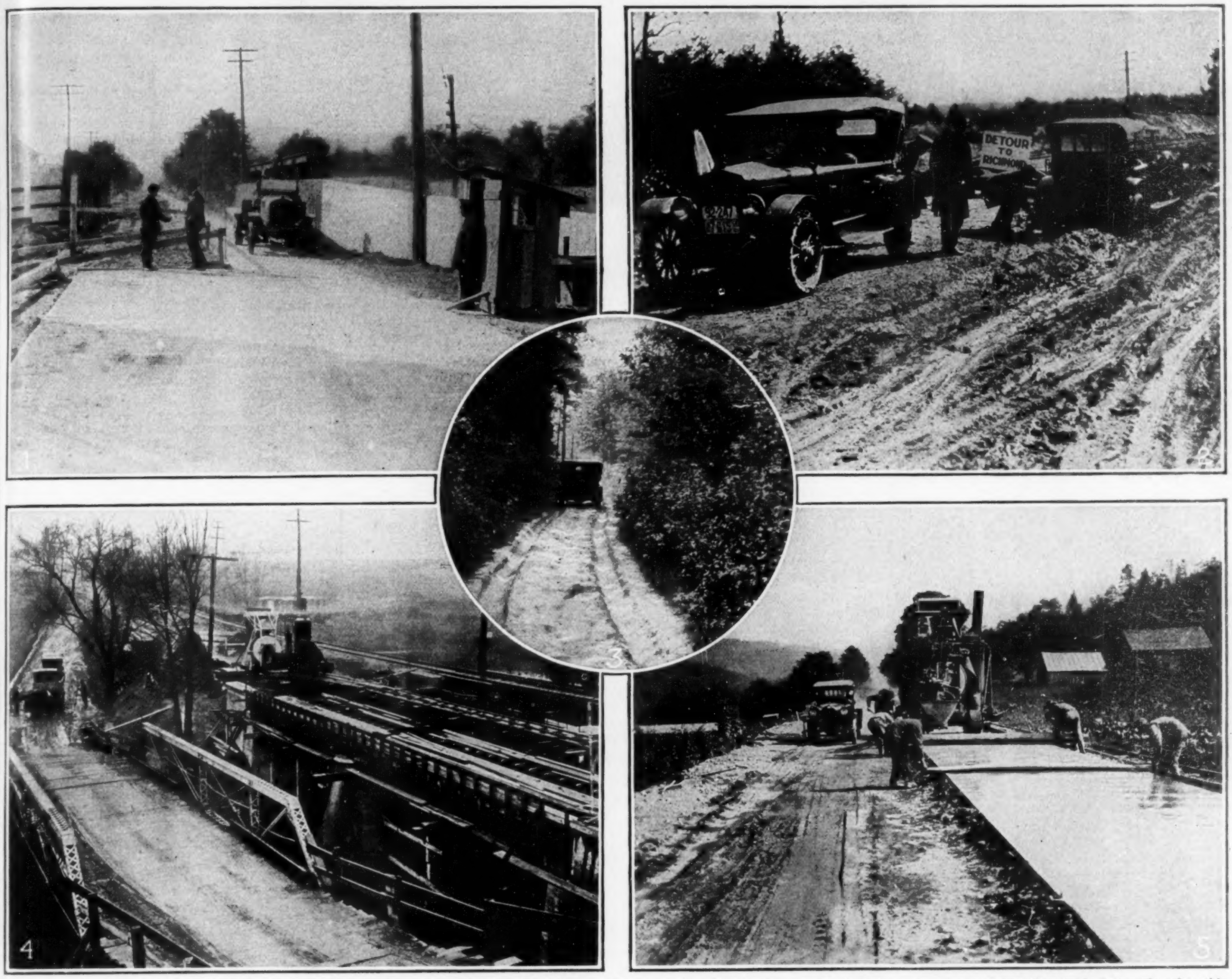
Even if you should run into somebody who could give you directions covering the next 50 miles, don't let him do it. Take from him only what you are sure



A scenic spot on the Lackawanna Trail through Pennsylvania, joining Binghamton, N. Y., with Scranton, and affording a new route between east and west

you will be able to remember; when this runs out, ask again. If you try to take your information in bigger bites, you will find that the other fellow's ideas, and yours, do not agree as to which junctions are puzzling and which are not. You will also find that, if there are five in your party, and if you let your informant tell you about more than the next two turns, two minutes after you leave him you will have exactly five versions of what he told you. Did he say five miles east, a short distance right to the first turn, and then you pass. What these gentlemen don't know, they can very quickly tell you where you can find. They will probably refer you frequently to Chambers of Commerce, where there is often a bright young secretary with a vast fund of very specific data about roads for many miles. Lay out your route in a very general way yourself; get more specific information as you pass through cities of good size, covering in a general way the route to the next such city; then, by using road signs and maps and inquiring your way along the road, back to the main road. If there are no proper signs or if you are in doubt, you will usually find nobody to ask at the critical point. The possession of an adequate map is then a life-saver. Locate yourself on it, use it as a means of judging which way to turn, and above all stay located on it until you get back on the main road.

You are presumably touring for the sake of the country. But you may want to see some of the big cities; and even if you don't, now and then you will



1. One-way traffic, controlled by telephone booth and flag signals, in Massachusetts. First the one side of the old road is kept open while half the new road goes down; then traffic is transferred to this while the other half is paved. The last car in each traffic stream delivers a red flag to the man in charge at the far end, as a signal to release the flow in the other direction. We have seen this system in operation over a distance of four and a half miles. 2. The sort of going you are likely to meet when main roads are under construction in Virginia. 3. This one, a sand road, isn't even a detour: it is typical of what one meets in various parts of the South where road construction has not caught up with automobile development. 4. A Clever Michigan job, in which the old bridge was shifted to a new location and used to carry traffic while the new bridge was being built. 5. This obvious one comes from Connecticut, but the author has met exactly the same thing in numerous other states—particularly in Ohio, where the Lincoln Highway between Mansfield and Galion was largely repaved in this fashion. The right of way is wide enough to obviate the necessity for one-way arrangements

A few interesting aspects of the problem of reconstructing roads without stopping traffic

north on the turnpike; or was it the next turn right on the pike, five miles north, and then go east? Nobody knows. But everybody is certain that he does know; so that you have the makings of (1) an elegant scrap, and (2) one touring party, hopelessly lost in a foreign land.

All this has to do with the details of keeping on one's route. If the route was well chosen in the first place, the difficulties of keeping on it will be minimized; if not, they will be at a maximum. A good choice depends first, last and all the time upon adequate information. There are organizations that specialize in such information, but most of them are on a membership basis, and if you are entitled to their service, you know it and know how to get it. Outside membership services, your best bet lies with automobile editors of the better papers in the commercial metropolis of your home section, and in the very largest of the cities through which make the jump from each village to the one that your map or your information indicates to be next. But be wary of the garage-man's information.

On the older-established, marked and named routes much of this is unnecessary. But the instant you get off of these it becomes vital. The best passage between given points will vary from month to month and often from week to week. Everything depends upon conditions of weather and of road construction, and upon whether bridges are in or out. The time you spend in pursuit of this information will come back to you with interest in the delays and retracings avoided.

No matter where you go, or how well primed you are, you will meet detours. Some of them will be expected, some unexpected; some well marked, others marked poorly or not at all. If they are properly marked, follow the sign faithfully—they will at least bring you run upon them. Almost everybody, for instance, who crosses the eastern half of the continent must traverse either Cleveland or Pittsburgh. A transcontinental itinerary will with equal probability bring you to Chicago or St. Louis. Driving parallel to the Atlantic Coast you will find Washington, Baltimore, Philadelphia, New York and Boston on your line of travel; on the other side of the United States a similar drive includes Los Angeles, San Francisco perhaps, Portland, Seattle. Buffalo, Rochester, Syracuse, Utica, Albany; Bridgeport, New Haven, Hartford, Springfield, Worcester; Milwaukee, St. Paul, Minneapolis—these are examples of the series of cities through which you may have to pass to get from where you are to where you want to go.

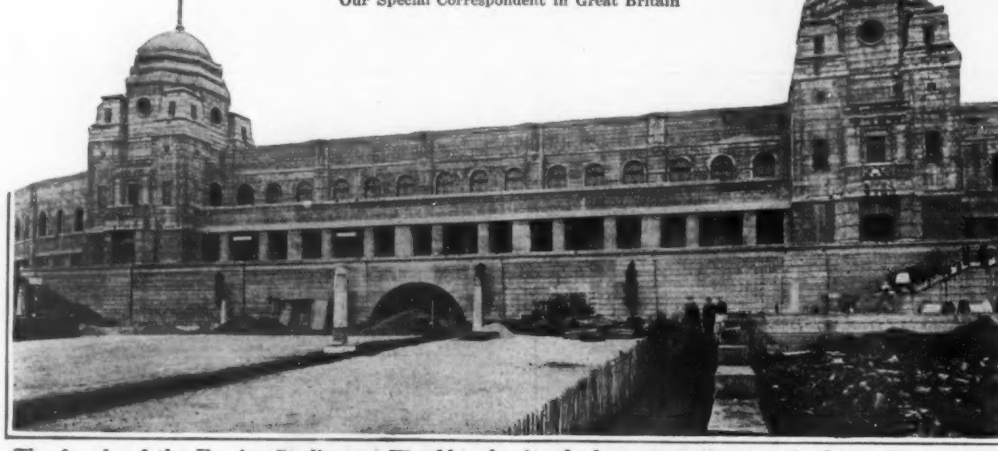
If city driving consumes less than five per cent of

(*Continued on page 136*)

The British Empire Exhibition

Wonders of the Comprehensive Exhibition Now Being Held at Wembley Park, London

By J. B. C. Kershaw
Our Special Correspondent in Great Britain



The facade of the Empire Stadium at Wembley, by far the largest sports arena in the world, providing seating and standing accommodations for 125,000 people

THE size and scope of the British Empire Exhibition, like the British Empire itself, is almost too big to be grasped without an actual visit. However, the following facts and figures will help those who read this article, to visualize some of its main features; and the accompanying views must necessarily give some idea of the vastness and picturesque character of some of the buildings and pavilions within the Exhibition grounds.

Wembley Park, which was selected as the most suitable site for the Exhibition, lies six miles north of London and is connected to all the main lines running in and out of the metropolis. So complete are the connections that Wembley can be reached in an average time of 18 minutes from 126 stations in central London, and tubes, trams, trains and buses will provide a never-ceasing stream of transport for visitors to the Exhibition grounds. From north to south the grounds measure about two-thirds of a mile, and rather more than this from east to west, the area enclosed amounting to 216 acres and being in the form of an arc of a circle.

Within this space the industries, manner of life and art of the 460,000,000 of people that inhabit the various portions of the British Empire, are represented. Fifteen miles of roadway and six miles of railway have been constructed within the grounds to facilitate communication between one part and another; and four railway stations outside and one within, will facilitate the arrival and departure of the crowds that visit the Exhibition. It is hoped to attract 46,000,000 of people, equal to the whole population of the British Islands, or an average of 300,000 per day, during the six months the Exhibition will remain open. Provision has been made for dealing with this number, and for feeding 30,000 within the Exhibition grounds at one time, without delay or confusion. Each section of the Exhibition will have its own restaurant provided with special local varieties of food; and visitors may thus take their lunch in South Africa, their tea in India, and finish the day by dining in Canada, Australia or New Zealand.

The buildings erected within the Exhibition grounds may be roughly divided into two classes, namely, temporary and permanent. The former, like those which house the Indian and Burmese exhibits, are, many of them, exceedingly picturesque and beautiful, but will be taken down when the Exhibition closes; and only the permanent buildings will remain for use on future occasions, namely, the Empire Stadium, the Palaces of Engineering and Industry, and the British Government Building. These have all been constructed of reinforced concrete, and serve as examples of the impressive and artistic effects which can be obtained with this material.

The Empire Stadium is by far the largest sports arena in the world, and completely dwarfs the Coliseum of ancient Rome. It was completed early in 1923, and provides seating and standing accommodation for 125,000 people. It is erected on the rising land on the south side of the Exhibition grounds, and rising to a height of 150 feet, it dominates the landscape for miles around. On the first occasion on which it was used for a big event, the Association Football Cup Final in April, 1923, difficulties were met with in controlling the huge crowd of 130,000 which attended and rushed the barriers. Better planning and organization of the entrance arrangements has enabled this difficulty to be overcome, and the opening ceremony of the Exhibition on April 23, and the Cup Final match on Saturday, April 26, were carried through this year without any hitch, although the attendance at each of these events taxed the capacity of the building to nearly its full extent, and put the approaches to a severe test.

The speeches of King George and the Prince of Wales were transmitted by electrical transmitters and loud speakers to all parts of the huge arena, and were heard perfectly not only by the 100,000 who attended the opening ceremony, but also by the millions of others who were "listening in" for the occasion, in their own homes all over the home country, and in some of the overseas colonies and dominions which form the Empire. Broadcasting, in fact, never before has had such a striking example of its value and usefulness, as it had on Wednesday, April 23, when King George V was enabled by its aid to address millions of his subjects scattered over half the globe.

The Stadium has been described before in these columns (see the October, 1923, issue), and it is only necessary to add that a special tunnel entrance has now been added, so that the wild animals which will be introduced into some of the pageants of Empire, planned for this summer, can be got in and out of the arena without any risk to the visitors. Historical episodes illustrating the development of the British Empire from earliest times, will be staged in the vast arena of the stadium during July and August, and the Army and Navy will contribute to these displays. The Boy Scouts are also holding a great jamboree of 10,000 scouts drawn from all parts of the Empire, during the first week in August. A series of six concerts with choirs of 10,000 voices and an orchestra of 500 instruments, will also be given in the stadium, which will therefore be the scene of a great variety of entertainments and shows, during the six months for which the Exhibition will be open.

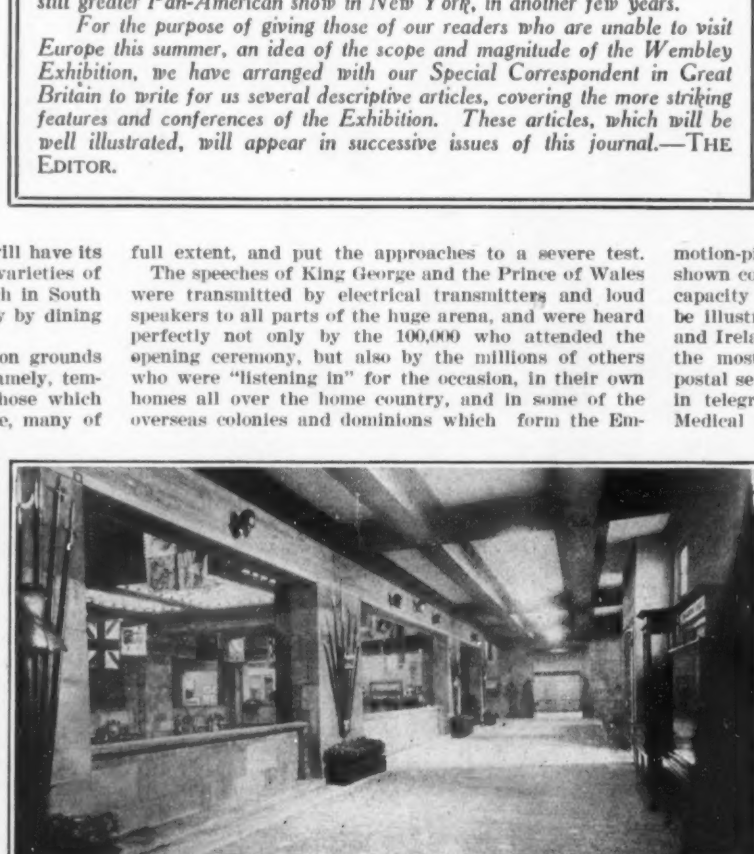
THE majority of American tourists and business men who cross the Atlantic this summer, will not return without having spent a few days in London for the purpose of visiting the British Empire Exhibition at Wembley Park. Americans are past masters in the production of things and events on a large scale; and an Exhibition which in every aspect can claim to be the greatest and most comprehensive "show" ever yet staged, is certain to interest them, even if it only supplies ideas for producing a still greater Pan-American show in New York, in another few years.

For the purpose of giving those of our readers who are unable to visit Europe this summer, an idea of the scope and magnitude of the Wembley Exhibition, we have arranged with our Special Correspondent in Great Britain to write for us several descriptive articles, covering the more striking features and conferences of the Exhibition. These articles, which will be well illustrated, will appear in successive issues of this journal.—THE EDITOR.

The British Government Pavilion, like the other main buildings of the Exhibition, is planned on severely classical lines. The portico shown in the accompanying view of this building is 32 feet in height; and the suites of rooms for use of the King and Queen when they visit the Exhibition, are situated on either side of it. In the central Court of Honour of this pavilion, a gigantic model relief map of the world will show, by means of changing lights, the growth and extent of the British Empire; and on a water stage 70 feet wide, which can be converted into an ordinary stage in a very few minutes, historical scenes on the sea, land, and in the air will be reproduced.

In an annex to the main pavilion is a motion-picture theatre where films of great interest are shown continuously; and the home country's productive capacity in relation to the home and export trade will be illustrated by a large-scale model of Great Britain and Ireland. The Post Office has an exhibit illustrating the most up-to-date methods in the organization of postal services, as well as the more recent developments in telegraphy, telephony and wireless communication. Medical and scientific research are well illustrated; and an important exhibit is that relating to tropical health and hygiene. The Royal Society of London, the oldest and most distinguished of the British scientific societies, has provided an exhibition illustrating the Empire's contribution to the progress of modern science, both pure and applied. The Ministry of Health, the Ministry of Agriculture, the Mines Department, the Imperial Mineral Resources Bureau, the Royal Botanical Gardens at Kew, and the Geological and Ordnance Survey are all well represented by attractive exhibits.

The two buildings which house the industrial and engineering exhibits are probably the largest that have been constructed in ferro-concrete; for they cover together a million square feet of floor space, and are striking examples of what can be achieved with this type of building material. They are placed one on either side of the main avenue of the Exhibition grounds.



Interior view of the British Government Pavilion, showing the spacious aisles and some of the exhibits

The Palace of Engineering, which is the larger of the two, is 300 yards wide and covers an area six and a half times that of Trafalgar Square, London. Five full-gage railway lines traverse the building from end to end, and are connected with the main trunk lines of the British railway systems. With the aid of these and overhead traveling cranes, the exhibits can be brought to the spot where they are to be shown, and can be installed with the minimum of labor and loss of time.

The section devoted to shipbuilding, marine, mechanical and general engineering, which is being organized by the British Engineers' Association, forms probably the finest display of general engineering ever brought together in any one exhibition. The electrical engineering section, organized by the British Electrical and Allied Manufacturers' Association, contains as one exhibit a power station, to the erection of which 40 firms have contributed. This station provides electricity for running all the machinery in the various sections of the Exhibition, and for lighting the entire exhibition at night. It is here that the public will see how the coal is tipped from the ordinary L. N. E. R. line into a special tipping bed in the ground, and is then conveyed by means of an underground tunnel to the bucket which transfers it to the feeding bunkers of the boilers.

The Motor Transport Section contains representative exhibits of motor cars, motors and accessories, and will constitute within itself a complete and attractive exhibition. In the Land Transport Section the exhibits of the great railway companies, and of the chief makers of rolling stock will be found; and in the Sea Transport Section will be shown the exhibits of the great ports of the United Kingdom. Exhibits which are sure to prove of very great interest are the large working model of an ordinary colliery, and the "Never Stop Railway," already described and illustrated in these columns (see page 89, February, 1924, issue). This latter is about half a mile long, and is worked by means of a continuous spiral screw, specially adapted to negotiate gradients and avoid all friction and jars. A feature is the claw which has been fixed at what may be called the semi-circular terminus, to transfer the carriages between the up and down lines.

The Palace of Industry, the other permanent building of the Exhibition, is rather smaller than the Palace of Engineering, and will house the exhibits of the industries of the United Kingdom, which do not come under the general heading of engineering. The largest single exhibit is that given by the chemical industry, which in all occupies an area of 37,500 square feet. The central feature of this display is an exhibit of research in pure chemistry. The Association of British Chemical Manufacturers, which has organized the whole chemical section, has been aided in this particular exhibit by the Royal Society.

Corner of the huge British Empire Exhibition at Wembley, with the vast crowds. In the background is the Wembley Stadium

Cotton textiles occupy 32,187 square feet; a representative committee covering all the Lancashire cotton interests has organized this section. The whole story of cotton production is illustrated here from the growing of the raw material to a complete working range of every kind of cotton textile machinery, ending in groups of exhibits of every sort of finished product. Woolen textiles, organized by a powerful Bradford Committee, fill 15,000 square feet.

Ulster and the north of Ireland industries occupy 6187 square feet. The unique status of the Government of this portion of Ireland as part of the Empire, is emphasized at the Exhibition. Instead of having a separate pavilion in the grounds, the Government has taken one of the most prominent corners in the Palace of Industry, and has organized there a show of the principal Ulster industries, including shipbuilding, flax and linen, and beverages.

Finally, in the section devoted to musical instruments, the visitor will be able to hear every sort of British instrument in a series of sound-proof rooms.

The pavilions which house the exhibits of India, Burma and the other far eastern portions of the British Empire, also the buildings of the self-governing Dominions—Canada, Australia, South Africa and New Zealand—will be illustrated in a later article. Some account will be given also of the very important conferences which have been planned for the summer months, on subjects of world-wide interest, as these reach the stage at which the reporting of their activities becomes profitable. The following are the more important of these:

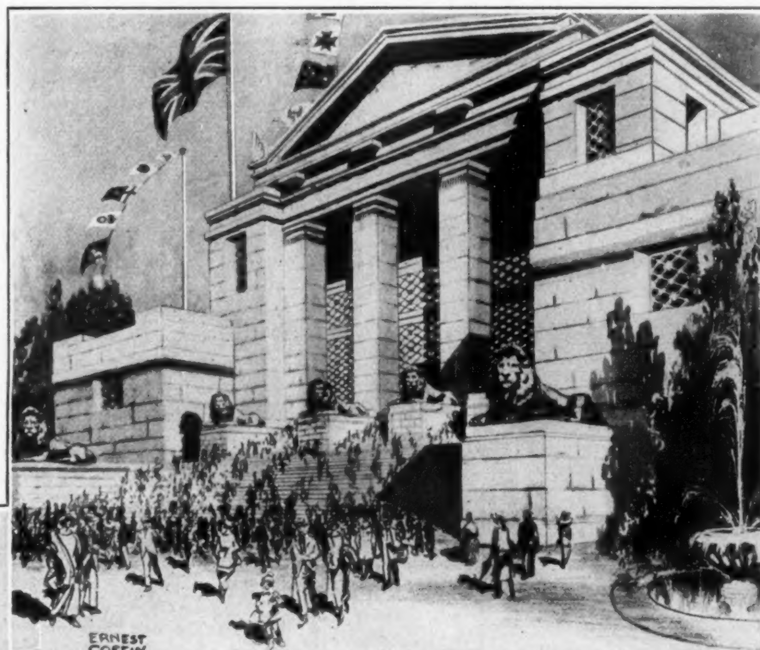
A Mining and Metallurgical Congress, organized by the Institute of Mining Engineers and Mining Association of Great Britain, and other bodies where interests lie in this field.

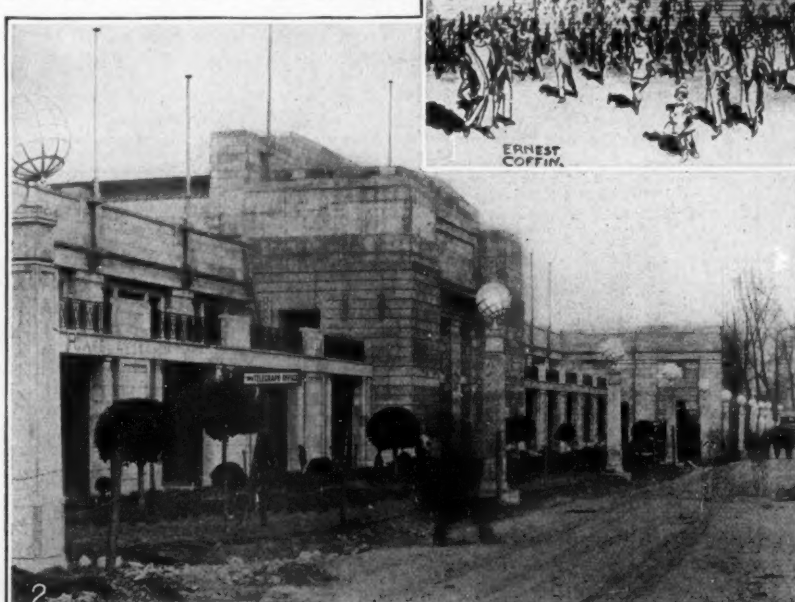
A World Power Conference, organized by the British Electrical and Allied Manufacturers' Association, and extending from June 30 to July 14.

An International Advertising Convention, organized by the Thirty Club, a prominent group of British advertising men.

A Textiles Conference, organized by the Textiles Institute, and aiming to cover the various technical and commercial problems that bulk large in this field.

Official delegates from all the leading manufacturing countries of the world are attending these gatherings; and the proceedings may be regarded as the nearest approximation to a World Parliament of Science and Industry that has ever been attained.





1: British Government Pavilion, with its severely classical lines. 2: The Palace of Industry, with its massive architecture and reinforced concrete construction. 3: The Palace of Engineering, also of reinforced concrete construction, and measuring 900 feet in width

Three of the major buildings in which the Wembley Exhibition is housed

Long-Range Weather Forecasting

Predicting Weather by the Year in Place of by the Day

By Herbert Janvrin Browne

Photographs by courtesy of Dr. C. G. Abbot, Smithsonian Institution

Measuring the curves for solar constant

LONG-range weather forecasting, a year or more in advance, is based on correct interpretation of the effect of solar heat on oceanic surface temperatures. The sun's heat is measured in terms of the solar constant.

Resultant changes in oceanic surface temperatures affect the temperature, speed and volume of the warm ocean currents, which in turn similarly influence the cold counter-currents and, together, the situs, extent and temperatures of the cold-water areas, particularly of the temperate and sub-tropical zones west of continental bodies.

In turn, the locations, extent and pressures of the sub-permanent oceanic meteorological highs and lows are governed and affected, with their resultant winds, and in general the temperature gradients between the oceans and the continents.

Hence the landward flow, volume and extent of oceanic moisture-laden winds are governed and can be quantitatively measured.

Studied in conjunction with the polar high pressure areas, the oceanic sub-permanent highs and lows can be used to forecast the frequency, intensity and courses of the cyclonic lows and anti-cyclonic highs which work to restore the equilibrium of tropical heat and polar cold and of surface and upper airs.

The foregoing synopsis contains the keys to the solution, not alone of long-range weather forecasting but of all weather forecasting not included in the empirical methods of the daily weather map. Ocean temperatures tend to stabilize the wider fluctuations of the atmosphere. In the end the former govern the general features of the weather. The full development of this method will require constant radio reports from vessels traversing the oceans, to secure daily surface temperatures and salinities, wind and current directions and force, air pressures, temperatures and humidities, with general meteorological observations. As there are thousands of vessels, including naval and other government craft, plying the oceans, from whose rosters sufficient competent volunteer observers can be secured, no great expense would be involved in the development of world-wide oceanic and weather forecasting available to all nations.

All weather comes primarily from the translation into heat of that extremely small fraction of the sun's radiation which impinges upon and penetrates the earth's atmosphere. Ignoring the wide and intricate variations in weather types due to latitude, lands, mountains, plateaus, deserts, oceans, clouds, polar ice, and the annual movement of the sun in the ecliptic, there remains an element of change which can be traced definitely to long-period fluctuations in the sun's radiation.

Astronomical science declares that the sun is a variable star, already well past its prime. Its shifting surface temperatures are under constant observation and measurement by the Astrophysical Observatory of the Smithsonian Institution, under Dr. C. G. Abbot and a corps of highly trained assistants. Two stations are maintained, one at Mount Harqua Hala, Arizona, the other at Mount Montezuma, Chile.

Slowly but surely the complex problems of interference by the various atmospheric elements have been solved. Each new solution has necessitated revision of the whole body of calculations, back to the inauguration of highly technical bolometric observations in 1905. But one important determination remains, that of the ozone element in the upper atmosphere. Ozone, the three-atom molecule of oxygen, is formed by the action of the ultra-violet rays. According to Dr. W. J. Humphreys, the eminent meteorologist, if all the ozone in the upper air were brought to the surface of the earth under atmospheric pressure it would form a layer no thicker than a pane of glass, and its effect is exactly that of a pane of glass in a greenhouse; it is transparent to the short-length waves of solar radiation, but is obstructive to the outward passage of the longer waves of earth radiation. Ozone may account for as much as three degrees of the earth's average temperature.

The open oceans cover about 65 per cent of the earth's surface and furnish probably nine-tenths of the moisture which waters the land. That moisture can be borne inland only by winds. Hence the key to the winds is the key to rain. Weather follows the winds. Winds blow in curves toward lower atmospheric pressures, therefore generally toward warmth. Continents are warmer than oceans in summer and cooler in winter. Hence moisture-bearing winds tend to blow landward in summer. This is modified in the sub-tropical belts by the tendency of winds to "blow trade" steadily from easterly directions at the surface and to "blow counter-trade" in the temperature zones, that is from westerly directions. But sufficient temperature-pressure gradients, it is found, will temporarily serve to overcome the trade and counter-trade winds.

The oceans, slow to respond to changes in solar radiation, surrender their accumulated heat with equal deliberation. From the beginning of 1917 to the end of 1920 the solar constant was high, running even to two gram calories per square centimeter per minute and averaging well above a normal of slightly under 1.94.

Using the Atlantic Ocean for illustration, the primary effect of this rise in the solar constant was an increase in temperature of tropical surfaces, and, in sequence, an increase in the temperature, volume and current of the Gulf Stream. The northern arm of the stream flowed into the Norwegian Sea and Eastern Arctic in increased volume and at a higher temperature. The sun in its northern tours still further aided in raising the temperature of Arctic surface waters.

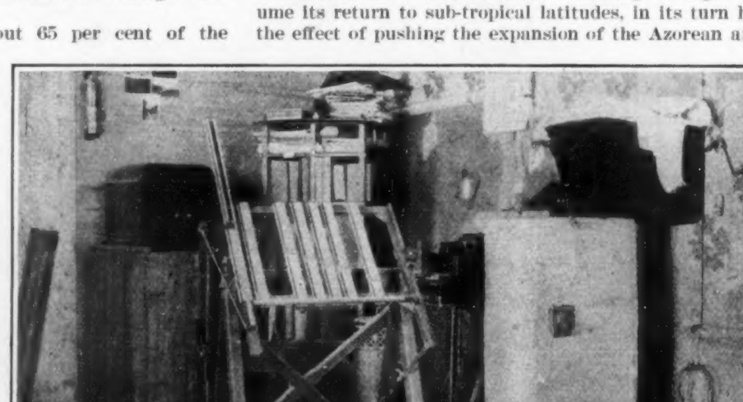
The Hoel expedition to Spitzbergen in the summer of 1922, sent out by the University of Christiania, reported an ice-free sea as far north as 81 degrees, 29 minutes, the furthest north ever reached in open water with modern oceanographic apparatus. The Gulf Stream could be traced as a surface current as far as 79 degrees, with a surface temperature of 15 degrees Celsius against a usual summer temperature of three degrees. Glaciers had melted, exposing for the first time on record open moraines; while the migrations of fish further indicated conditions not paralleled in a century. It should be noted that the beginning of these changes was dated back to as far back as the year 1918.

The increased flow of the northern arm of the Gulf Stream and the further heat expansion of Arctic waters necessarily displaced an equivalent quantity of cold water, which pressed south and in large part found its expansion in the cold-water area which generally lies between the Azores and the Spanish Coast. But the southern arm of the Gulf Stream seeking in larger volume its return to sub-tropical latitudes, in its turn had the effect of pushing the expansion of the Azorean area

Smithsonian Observing Station, Bassour, Algeria, in 1912

Mount Harqua Hala Station, Arizona

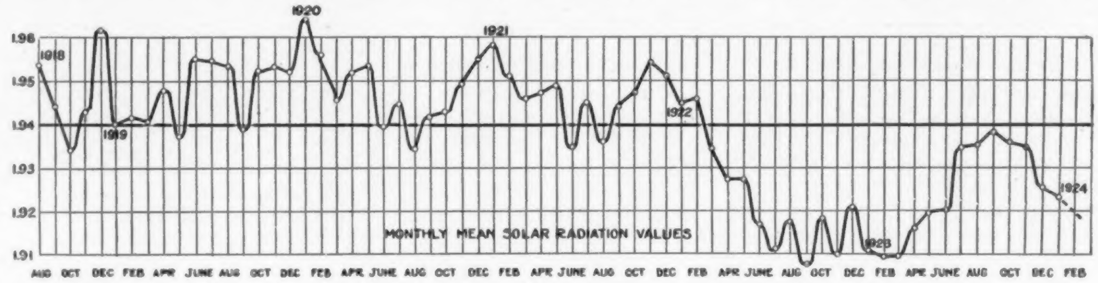
Making solar observations at Mt. Washington, Chili



Slide-rule machine in computing room, Smithsonian Observatory, Calonia, Chili

by the year 1922 several hundred miles south and west.

Sequences now appear, lagging in their effects several years behind the initial cause in the rise of the sun's heat in 1917-20. It will be noted that the average temperature of the United States in 1922 was over three degrees above the normal. The autumn of 1922 and the winter of 1922-23 were notable in this country for lack of rain and snow. The northwestern lows, which usually penetrate deep into the Mississippi Valley, crossed the Continent near the Great Lakes, acquiring vitality only as they approached the Atlantic seaboard, where, with the onset of winter, they gave New England almost the heaviest snows on record and then raged across the Atlantic, which for six months had the severest storm period in 100 years.



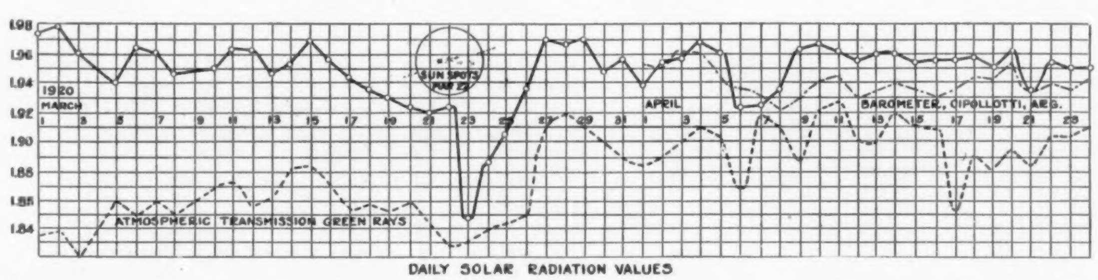
The above illustrates the variation in the sun's heat from August, 1918, to February, 1924. Its place, well below the mean of 1.94 since February, 1922, has a deep significance in the world's meteorology

These lows strengthened by their contact with the Gulf Stream, moved generally into the Eastern Arctic and Norwegian Seas, and emphasized the ascending winds which rotate spirally inward to the left around the Icelandic low. This course in turn emphasized with strong northerly winds the cold countercurrent which flows down the east coast of Greenland, around Cape Farewell and into Davis Strait, where the ice fields were broken at an early date and set free their huge masses and the iceberg fleets which made notable the spring Atlantic of 1923.

The permanent oceanic atmospheric lows are invariably formed over bodies of water warmer than the air, and generally near continental masses which, in winter at least, develop highs.

The Azorean cold water area, lying in the northern belt of high pressure which encircles the earth, builds up an atmospheric high by its chilling effect, around which the descending air currents circle spirally outward. The expansion of this cold water area south and west in the period following 1918-20 has developed stronger winds than usual, which in turn tend to blow the surface waters, as they warm, outward in all directions toward the encircling Gulf Stream. On the southerly quadrants this gives winds which drive chill moisture into the South Atlantic and East Gulf States, where during 1923 and to date the rainfalls have been excessive and injurious to agriculture, particularly to cotton. Similarly, the northerly quadrants develop the moist winds which have for the past 12 months deluged Spain and Italy with torrents of unheard-of rains. These analyses of weather causations can be applied to every comparable continental area in the world with similar results.

Beginning with January, 1921, the solar constant declined rapidly from its high of 1917-20 until by September, 1922, it stood at 1.913, the lowest mean recorded since the beginning of observations in 1905. It remained persistently low until in March, 1923, when it recorded 1.908, then rose to 1.936 in August, still below normal, and then resumed its downward course. It is, at present writing, at an extremely low point. The shift from the mean high of the 1917-20 swing to the low of 1921-24 indicates a decline of over 3.6 per cent in the solar temperature reaching the earth's atmosphere and, as nearly as may be determined, corresponds to a decline of 4.6 degrees Fahrenheit in the earth's temperature. There is, of course, no even distribution over the earth of that decline in heat, but the assertion is made with confidence that the main weather features of the years 1923-24 are measurable through interpretation of the solar constant of 1917-20, and that the weather for 1925-26-27 has already been determined by the solar constant of 1921-24.



The circle indicates the position of a large group of sunspots central on the sun March 22, 1920. The deep minimum of solar values on the day following was almost certainly caused by the presence of the spot group. The simultaneous depression in atmospheric transparency, as indicated in the green rays curve, may have been caused by the bombardment of the earth's atmosphere by ions from the sun which acted as centers of condensation of haze

The transition from the solar high of 1917-20 to the low points of 1921-24 has been characterized by violent fluctuations of weather all over the world. The open Arctic of 1918-22, with the Russian famine of 1921-22 and an extremely mild winter in Scandinavia in the latter period, couples now in 1923-24 with the severest winter of many years in the latter country, and with ten months of almost continuous rain in the Hebrides off the west coast of Scotland.

The last week of spring, 1923, saw black frosts in Southern England and snowstorms in Italy, France and Austria with freezing temperatures, breaking records of over two centuries. The Azorean cold area was so far south and west in 1923 as to disrupt completely the West Indian hurricane season. In the Southern Hemisphere the winter of 1923 saw unprecedented snows in Argentina and New Zealand, while both 1923 and 1924 have recorded floods of great severity in Africa and South America.

Observatory at Mount Wilson, Cal., for studying sunspots and other physical phenomena

The wide expanse of the Pacific permits the Japanese current to complete its circuit and leave the Pacific cold-water area outside its eastern curve. This area usually lies, under normal conditions, between Southern California and the Hawaiian Islands while over it the sub-permanent Pacific high develops. Under the changed conditions of the last few years this cold-water area has expanded to the north well up to Vancouver Island, with a marked development of high pressure areas in contact. The resultant westerly winds on the northern quadrants blow excessive rains into Washington and Oregon, while the winds are easterly on the southerly quadrants over central and southern California where one of the worst droughts since white men have been in the country has been in progress since last October. Note should be taken of the fact that the southern Sierras, which normally receive from 15 to 20 feet of snow, giving storage for the summer irrigation, were bare all winter.

The writer is already on record elsewhere as having forecasted the year 1924 as on the whole a cold-dry year in the United States, wet in the southeast and extreme northwest, moist in the usually dry range country and the plateaus, and drought-stricken in the country east of the Mississippi and north of the Ohio and Potomac, as well as in central and southern California. It may now be stated that every comparable area in the world has had recently, is having, or will have this year similar weather.

Attention should be directed to the fact, discoverable by examining the logs of thousands of vessels plying the seas, that the oceans are now over enormous areas well below their seasonable temperatures. It is not a prophecy, but a forecast based upon meteorological facts already in evidence, for those who can correctly interpret, that the year 1925 will be a severe one generally throughout the world, and that 1926-1927 may witness a return of 1816, the "Year Without a Summer."

The 1926-27 years should see the 55.6 year of sunspot maxima with a resultant further drop in solar radiation, and its immediate response in declining atmospheric temperatures over wide areas. Oceanic temperatures, already low and certain to so continue, will add their influence. One further element alone is required to reproduce the weather of 1916—a violent volcanic eruption like that of Asama in 1783, Tomboro in 1815, or Krakatoa in 1883, or a series of lesser ones but sufficient to throw into the upper air a huge volume of volcanic dust—to reduce the earth's temperature to the required degree, some 10 degrees Fahrenheit. In 1816 there were no crops raised north of the Ohio and Potomac and but scanty returns much further South. Frost, snow and ice appeared in every month of spring, summer and fall.

It would not require a completely cold summer to spell disaster. Twenty-four hours of temperatures below freezing about June 10 and a similar period about July 10 would destroy the grain crops of the United States and Canada, as well as nearly every other growing thing. In 1816 ice a half inch thick was formed in the East on July 4.

Portraits of Columbus

A PORTRAIT of Christopher Columbus found a short time ago and now in the Sherman collection at Rome is attributed by G. Soulier to Titian. It is true that the portrait lacks the spontaneity and spirit that characterize most of Titian's work. It is in this respect like his portrait of the doge Marcello, which is a posthumous portrait. The Sherman picture of Columbus also was executed after the death of the navigator. For Columbus died in 1506 and Titian's portrait of him could not have been done before 1508. The engraving of Columbus by Capriolo is so closely related to the Titian painting as to suggest that it was copied from the latter. But it is also possible that both the engraving and Titian's painting were derived from a third picture. If this be the case, the picture in question, quite unknown, affords an alluring object for search.

Our Point of View

Unredeemed Ugliness in Bridge Construction

WORK on the new suspension bridge across the Hudson at Bear Mountain has progressed to a point where one can gain a good impression of what this great structure will look like when it is completed. The towers are up, and the working platform, carried on temporary cables, shows the sweep which will be taken by the permanent cables. We confess to great disappointment with the result. The whole design, from abutment to abutment is stiff, spindle-legged, and inartistic—and this in a location where Nature has challenged man to do his artistic best.

On its completion, a few months hence, the Bear Mountain structure will carry the double distinction of being the longest suspension bridge in existence and built on the most attractive site of any great crossing of its kind in the world. Here, surely, were an opportunity and an appeal that should have urged its builders to design a bridge, which, in its artistic and architectural treatment, would have been harmonious with its surroundings. To such treatment the suspension type is peculiarly adapted. The graceful sweep of its catenary from tower to tower—this curvature being determined by Nature in agreement with the laws of gravitation—imposes an obligation upon the engineer to carry into the towers and the approaches some of the beauty that is so conspicuous in the cables.

But considerations of architectural beauty seem to have had no part in determining the outlines of this bridge. On the contrary it shows evidence of having been designed with a single view to the saving of dollars. The steel work is straight-line throughout; for, outside of the cables, there is not a curve to be seen in the whole structure. Straight-line work, however, is cheap and curves cost money.

So there you are!

The towers of a suspension bridge lend themselves to artistic treatment—as witness the Manhattan bridge—but each tower of this bridge looks like a pair of telegraph poles tied together with a skeleton of bracing. Each of them would make an excellent gallows frame for a suction dredge, or one of a series of towers in a high-voltage transmission line. Standing as they do on the banks of the most attractive stretch of the Hudson River, they are a blot upon its beauty that will call down the angry censure of future generations.

"What manner of people were those of the early years of the Twentieth Century," they will ask, "that they should have stretched so crude a structure across our stately river? Were they entirely dead to all artistic feeling; had they not even an elementary sense of the fitness of things; was there no outstanding engineer who knew how to wed strength to beauty, as did the ancients and as we have learned to do today?"

Such questions will they ask in the coming centuries and, alas! there will be none to answer that this was a period when art was being crowded out by commercialism, and when the first question asked of a structure was "what will it pay?" and the last "how will it look?"

The unredeemed utilitarianism that has spoiled the towers has left its ugly hand as well upon the piers and trusses of the approaches. It would have been easy and inexpensive to mold the piers and abutments into appropriate forms; whereas they are as straight, rectangular and stiff as the towers, without base, capital, or any signs of legitimate adornment.

There is talk, these days, about the standardization of big bridge construction. If this can be brought about, well and good; it may lead to certain economies. But the engineer-contractor should move circumspectly. So far as architectural effects are concerned, standardization may be applied without serious results to short-span structures; but a wholesale introduction of standardization in long-span bridge design is liable to lead to—well, to just such hideous artistic failures as this contractor's bridge that obtrudes its ugliness upon one of the beauty spots of America.

The Naval Situation

DURING the past few months, the public has been presented through the daily press with a vast amount of discussion of the supposed weakness of the United States Navy and its failure to measure up to the 5-5-3 standard. The greater part of this literature, so far as the standard is concerned, was entirely wide of the mark; this for the reason that it covered naval material that does not come within the scope of the Washington Treaty, which dealt exclusively with capital ship and airplane carrier strength. The Treaty, as finally drawn, had nothing to say about the relative strength of the navies in unarmored ships—cruisers, destroyers, submarines, gunboats and supply ships. Hence, all these attacks on the Washington Treaty, so far as they deal with unarmored ships, miss the point entirely and have nothing whatever to do with the question. Therefore, let it be again asserted that under the Treaty the United States holds today its full value of 5 in the 5-5-3 ratio.

The standing of the United States relatively to Great Britain and Japan, in unarmored ships, is not satisfactory. So far as numbers are concerned we hold first place in destroyers and submarines, and in quality our destroyers are, on the average, superior, being relatively quite modern, of high speed, and carrying an unexcelled torpedo armament. The submarine situation it must be admitted is far from satisfactory, though not nearly so bad as some irresponsible alarmists have stated. We are weak in sea-going submarines capable of accompanying the fleet; for these Congress should make the needed appropriations. In the matter of light or scout cruisers we are relatively weak; but we have made a very fine start with our ten 9000-ton, 34-knot cruisers of the "Richmond" type. However, since other nations are building a certain number of cruisers up to the Conference limit of 10,000 tons, and armed generally with guns up to the Conference limit of eight inches calibre, Congress should appropriate for at least eight ships of this type.

In view of the many sensational articles that have been written about the renewed shipbuilding competition in unarmored ships, we here and now emphatically assert our conviction that since the war there never has been and there is not now any such competition. The cruisers which the various nations are building are only such as the depreciation of the older ships at the bottom of the list necessitates. There is naval peace in the Atlantic and in the Pacific, and if our irresponsible Congressmen will only refrain from such unwarranted insults as that recently offered to Japan, this peace will be unbroken we believe for many a decade to come. If Congress had left this matter in the hands of the President and the Secretary of State, the desired result would have been achieved without offence to the racial feelings of a friendly people.

The Mysterious "Death Rays"

AMONG the perennials of science is the mysterious ray. Every so often we are startled by reports of a new ray with strange and terrifying properties, intended for such gentle tasks as paralyzing airplanes in flight, exploding ammunition dumps at a distance, blowing up battleships by detonating their magazines, killing enemy troops by the wholesale, destroying the power houses of the enemy, and bringing to a halt every automotive vehicle in the enemy's territory.

The mysterious ray is a true perennial of science. It was talked about when Tesla, the well-known American inventor, experimented with his high-frequency currents in 1898 and burned out and put out of commission the generators in a power house several miles away. In 1915 an Italian made startling claims regarding a ray which would destroy anything on which it was concentrated, and again we heard of the stopping of generators at a distant power house. A year or two ago the rumor reached us to the effect that the Germans had a mysterious ray which they were using to down French airplanes flying over Bavaria on their way to the friendly cities of Prague and Bucharest. Almost a year ago a French inventor is said to have demonstrated a mysterious ray which caused Parisian taxicabs to stop when directed against them. Recently, the garrulous Trotsky has told the world to beware of a new Russian death ray. The German militarist, Herr Wulle, has informed the Reichstag that the Fatherland has a diabolic ray with which to play havoc among unfriendly airplanes, tanks, and so on. Marconi, from time to time, has been working on some mysterious ray for destructive purposes, according to rumor. Great Britain has Mr. H. Grindell Matthews and his diabolic ray which, thanks to extensive publicity, occupies the forefront of the mysterious ray furor of the moment.

What are these death rays, diabolic rays, death-dealing rays? No one except their sponsors really knows. We are told all kinds of astounding things but given no proof, except a few unimpressive laboratory experiments. On the basis of our present scientific knowledge, there is a very slim foundation indeed for these mysterious rays which may be projected through space and cause the destruction of ignition systems, the explosion of powder, the burning up of structures, the destruction of life, and so on.

Groping about in pitch blackness, so to speak, we are frankly skeptical of these mysterious rays. Perhaps they have some of the properties attributed to them, but on a very modest scale. They are little more than laboratory experiments, from the scientific viewpoint. When it comes to bluffing enemy nations and even one's own military leaders—well, death rays after all may have some tangible value.

Cashing in on Panama

THE SUCCESS of the Panama Canal as a great engineering venture has never been disputed. That we should have gone into this fever-infected district and cleaned it up until the health conditions compared with those of any American State; that we should have taken hold of a vast engineering project in which the French had failed; that we should have doubled the proposed size of this work and then built it for less than the cost as estimated by our army engineers, was an accomplishment in which all Americans feel a justifiable pride. Not only was the canal costly to build, but there was always the lurking fear that it might not attract sufficient traffic to pay even the cost of operation to say nothing of sufficient returns to amortize the expenditure of capital. Today, however, after less than a decade of operation, the canal is not only paying its way but is showing a very respectable and rapidly increasing surplus of earnings over expenditures. Thus, the budget director reports that up to the beginning of June this year the canal totals have amounted to \$25,634,780 as compared with \$15,688,447 at the beginning of June last year.

Now the upkeep and general operation of the Panama Canal costs approximately \$5,000,000 a year, which must be met before any payment can be made toward the wiping out of the cost of the canal, which is not far below \$400,000,000. If the present phenomenal increase in traffic is not ephemeral—that is to say, if it is not due mainly to such sources of traffic as the carriage of oil from recently developed western oil fields to the eastern refineries, which will diminish if the oil fields run out, the total amount of surplus, after paying the current expenses, will begin to reach a figure that year by year will appreciably reduce the present debt.

Furthermore, there need be no anxiety on the score of the capacity of the canal. It is operated at present only during daylight. It will be perfectly possible, when the demand comes, to operate it safely throughout the whole twenty-four hours, and since the canal could easily carry, during any given period of time, twice as much traffic as now passes through it will be seen that there is a wide margin for future development.

Here and There

MUCH space has been given, in our own columns and in those of the daily press, to the helium gas employed in the bags of the "Shenandoah." Now it has been the explosibility of hydrogen and the non-explosibility of helium; now the great expense of producing the latter and again the progress made in producing it at a reasonable figure; now the certainty of a sufficient supply to warrant its use in the big dirigible; now the remarkable invention whereby water ballast is recovered from the burned gasoline sufficient to regain the loss in weight caused by the consumption of the fuel, so that the helium, still more expensive than we should like to have it, need not be released to decrease the buoyancy of the ship and permit a landing; and as the latest chapter, we have the accident which led to the necessity for valving some thousands of cubic feet of the precious helium, in spite of the ballast-recoverer, to avoid the necessity for keeping the ship in the air all night in a fog. More or less a central figure in all this is Harold S. Kennedy, chemist at the Bureau of Mines, who has had his finger very much in the pie throughout the experimental work leading to the use of helium in aviation. So very central is he, indeed, that the tendency of the daily press to look upon him as the "discoverer" of helium may be pardoned. Mr. Kennedy's portrait appears at the upper right corner of the page.

IN this connection it may not be amiss to recall the actual circumstances under which helium became known to us and acquired its name. We should, as a matter of fact, reverse this remark, and put the acquisition of the name first. Away back in the 1860's, spectra of the sun taken during eclipses began to show, under the refined instruments then for the first time available, lines in the yellow region, corresponding to those produced by no known element. The only conceivable explanation was that they pertained to some element which either did not exist at all on the earth, or which had not yet been isolated; and the assumption would naturally be that this was a very light gas, which would be sought in appreciable quantities mainly in the inaccessible upper regions of our atmosphere. It was not until 1895 that Sir William Ramsay finally isolated, from ordinary atmospheric air, a very small percentage of a gas, hitherto unknown, which gave these same spectral lines. The tentative identification with the substance present in such quantity in the atmosphere of the sun was very soon made perfect, and in recognition of its curious history it got its name—which, for the benefit of the non-classical, we may remark is derived from the Greek word for sun.


Dr. Robert A. Millikan

ONE of the standing jests about the typical American is that no one has qualified as a genuine product of our soil until he invents something and takes out a patent on it. There is another rather characteristic trait that is not noticeable among our city dwellers, for lack of opportunity, but that could almost be advanced as a prerequisite to the rights and privileges of citizenship in our rural districts—and that is, to have discovered a vein of mineral deposit of some sort, and to have got more or less excited over the prospects. The farmer who doesn't have this happen to him spontaneously usually fails, sooner or later, in the course of digging a cellar or a well. When he does, he sends his specimens to his Uncle Samuel for analysis and report; and the gentleman whose portrait the reader's eye has just left behind does the rest. He is George Steiger, chief chemist of the Geological Survey. One of the duties of the Survey is to keep track of our mineral wealth, and hence it is natural that the task of analyzing the samples of ore and near-ore contributed by our various hopeful citizens should fall under its jurisdiction. Thousands of samples are sent annually, by persons thinking they have found gold or silver or some other valuable deposit. Mr. Steiger and his assistants find that about 20 per cent of the specimens consist of mica or pyrites; and a large proportion of the balance have their value in such shape that extraction would be unprofitable. But the Geological Survey's chemical shop doesn't confine its activities to volunteer contributions; the Survey has men all over the country whose whole business is to dig up and submit for test promising samples, and Mr. Steiger's most profitable work is in the assay of these ores, and the publication of the findings for the guidance of miners, oil men and prospectors generally.


George Steiger

IF we were asked to name America's foremost physicist, we should probably demand a further classification, on the plea that physics has so many branches that comparison between the foremost electrician, the foremost student of atomic structure, and the foremost worker in engineering physics would be impossible. But whether we were granted this reclassification or not, we could not start our list of leaders without the most serious thought to the place to be given Dr. Robert A. Millikan, of the California Institute of Technology. Dr. Millikan's specialty is atomic physics, and he has done about as much as any other American toward the present very satisfactory development of this branch of science. His experiments looking toward the measurement of atoms and electrons are fairly to be characterized as epoch-making, and have constituted no small contribution toward recognition of the fact that the electron and proton are not mere names, but actually correspond to the realities of the case. It is his work in this field that has earned him a Nobel Prize award. Judging from his face, he might stand, with so many others of the present generation of science, as representative of the twentieth century type that shines equally in the abstruse works of science and in the practical affairs of life.


Dr. James H. Breasted

MORE suggestive of the old-line professorial type, which is more or less buried in study and more or less detached from mundane things, is the portrait of Dr. James H. Breasted, of the University of Chicago. For a full generation, almost, Dr. Breasted has stood in the very front ranks of Egyptologists. He is fairly well known to the reading public as author of a book which puts the history of Egypt in living form before the modern reader; and among his scientific colleagues he is recognized through the very monumental work, of dictionary size, of which the smaller and more popular volume is an abridgement. The longer book, in fact, occupies the same place in its field that is held by Gibbon's masterpiece in the history of Rome. Dr. Breasted does not come into the public eye as often as the leaders in some other departments of research, but the Tutankhamen finds have given him an opportunity to see his name in print, for there is nobody in this country whose opinion on them is of more moment than his, or whose study of them more fruitful.

AMONG the scientific personalities of the month is the announcement that Roy Chapman Andrews, working for the American Museum of Natural History, will be in Mongolia and Central Asia for a year, starting next spring, in search of early human and pre-human remains. As an example of the possibilities, a single bank of Tertiary deposits 1000 feet thick was located last year and will receive the attention of next year's expedition. On the basis of finds to date, the Museum authorities are inclined to believe that the Gobi regions were, as long as 3,000,000 years ago, the habitat of a distinctly pre-human species.


Harold S. Kennedy

AN interesting echo of the war—literally as well as figuratively—was heard in Paris in May, when a charge of ten tons of melinite was detonated, in the attempt to duplicate, for careful study, the "zones of silence" phenomenon observed during the war. It will be recalled that heavy bombardments were frequently heard by observers 100 miles or more distant from the scene, while at points in the same line but nearer—say 50 or 60 miles—nothing was heard. The results, so far as compiled up to our press time, rather bear out the theory that the remote audibility is due to sound waves traveling in curved paths through the upper air and descending to the earth beyond the range of those that travel along the surface.

ENTRIES have closed for competition for the British Air Ministry's prize of 50,000 pounds for a helicopter fulfilling the conditions prescribed when the test was announced a year ago. There are between 15 and 20 entrants, including some of the most notable European and American experimenters in this field of flying. It remains only for the Ministry to fix the date for actual trials, which will be held at some big British airdrome. To win the prize a machine must perform a straight up-and-down flight attaining an altitude of 2000 feet; a hovering flight of half an hour; a circular flight of 20 miles at sixty miles per hour; and a descent from an altitude of 300 feet into a small area with the engine stopped. This, suggests a conservative British journal, implies the production of a machine altogether too far beyond the present apparent stage of helicopter development to justify the expectation that the prize will be won by any of the present applicants.

ON the evening of Thursday, June 12, we witnessed—and heard—a striking demonstration of the fashion in which the very latest scientific developments have been seized upon by the purveyors of news, and made a part of the routine of twentieth-century space annihilation. In the sitting room of a private residence in Englewood, N. J., we listened to the nomination, in Cleveland, of a Republican candidate for Vice-President. Nor was it any fifth-hand summary of what was going on upon the convention floor that reached our ears. We heard the chairman poll the States and announce the results to the floor. The spokesmen for most of the State delegations were seated sufficiently close to the platform, with its microphones, for us to hear their announcements to the Chair, preceding the Chair's announcements to the convention. The cheering that accompanied heavy voting for favorite aspirants, the misunderstandings between Chair and floor, were but examples of the perfect reproduction of convention atmosphere by our loud-speaker, as by thousands of others all over the country. But we got a kick out of the occasion that was denied the average listener; for we had with us, for display to our friends, photographic prints of the convention pictures made that day and transmitted to New York by telephone—a process so new that a description of it appears only in this issue. Between radio and pictures, we were in the actual presence of the convention to an extraordinary degree.

Growing Our Own Bananas

How Florida Is Establishing a New Crop in Competition with More Tropical Lands

By James H. Collins

An aisle in a full-grown Florida banana plantation, showing close-set plants that bear heavier crops than in the tropics

A SALES manager in Detroit had a banana plant. It was the apple of his eye, his pride and joy, a Giant Abyssinian *Musa ensete*, that he had raised in a flower-pot from a baby bulb, and kept outdoors in summer and indoors in winter. The strangeness and grace of the exotic plant-creature fascinated him, and under his fatherly care it throve apace.

In Abyssinia, *Musa ensete* grows 30 feet high. In Detroit, it attained the magnificent height of two feet, and was the wonder of the neighborhood until one zero night when, left too close to a window, it froze to death.

Do you remember, as a kid, losing your first dog—or kitten? It was like that, and he never forgot. But he never had the heart to adopt another banana plant —until—

One day this sales manager found himself bound for Florida to take charge of a large land development being carried out near Tampa by a Detroit automobile king. Florida was new and alluring, with its citrus fruit, avocados, palms, sugar cane, velvet beans and strawberries in December. But most of all, he liked the banana plants that stood in every Florida garden, and traveling over the State to get his bearings, was astonished to learn how the banana was being neglected.

Last winter Florida raised so many oranges and grapefruit that the market was glutted, and prices fell below the cost of production and shipping. Florida has for years supplied the first strawberries of the season, around Christmas or earlier and the first peppers, tomatoes, beans, celery, lettuce, new potatoes and other vegetables. But despite the State's enterprise in specialty crops, the banana was not grown commercially—or only locally in a small way. The fruit was brought in by the early Spanish settlers from the Indies or Guianas, and for four hundred years has been a door-yard crop, supplying the family. Occasionally, when a Floridian found more bananas in his garden than were needed for home use, he took a bunch or two into town and sold them to a grocer, generally for a very satisfactory price, because the tropical banana, brought all the way from New York or New Orleans, sold for seven to ten cents a pound. A few grocers had small commercial acreage, selling to nearby cities, but there was, properly speaking, no banana industry in Florida nor in any part of the continental United States.

In competition with the tropical banana, those grown in Florida had two shortcomings. They were of dwarf variety, about half the size of the fruit-stand banana, and therefore not attractive to purchasers who did not know their fine quality. And being dwarfs, they did not yield the tonnage per acre the banana grower depends upon for profit.

In the great consuming markets of the North, people eat fruit principally by the eye, paying the best prices for size and color. A banana like the little "Ladyfinger" grown in Florida door-yards would quickly gravitate to the pushcarts of the East Side, and be sold with difficulty there, because it is no great shakes to look at. Have a little faith, however, peel back its yellow skin, and bite into the ripe flesh, with the rich flavor of the tropical red banana, and you will discover something new in the way of a delicacy.

"Some day the great American consumer will learn to eat by flavor instead of size and color," reflected the Detroiter. "Then there ought to be a market for these dwarf bananas as good eating. But why are they small—can't Florida raise large bananas?"

He began asking questions, talking with anybody who could tell him anything about bananas, particularly the hospitable "crackers" who had lived in Florida all their lives, and knew many things not perceptible to the tourist or recent settler. He discovered that fine-flavored big bananas in bunches weighing 50 to 100 pounds and over, as attractive as any you ever saw hanging in a fruit dealer's window, could be grown in Florida. They were already growing there — his cracker friends took him out back and exhibited full size Red Jamaica fruit on healthy plants, and gave him plants for his own garden. Florida bananas were generally small, not because nothing but the dwarf variety would grow there, but because the plants had degenerated, or were not fertilized or cultivated, simply growing like Topsy.

Heavy-bearing stand of the Hart variety of Florida banana, with tall plants that rival the palm tree in foliage

The northern greenhorn, Mr. W. E. Bolles, became a banana enthusiast. He got plants of several varieties and began growing them with regular cultivation and fertilization on his place near Oldsmar. Big bunches of fine-flavored fruit resulted, and they were raised at a cost that made it possible to compete with tropical bananas and clear a fine profit to the acre. Bolles grew so enthusiastic that he sent out letters calling a meeting of people interested in bananas, for the purpose of organizing a banana-growing association. On the day before the meeting an unusual rain and wind storm arose.

"If I hadn't been the one who set the ball rolling," he admits, "I wouldn't have gone to the meeting myself. But it was my duty to be there, and I persuaded a friend to go with me. As we drove into town, he said he had some shopping to do, and would come around after the meeting got started. Walking boldly into the hall, I found myself the only one there, and not another soul showed up the next half hour. Leaving the hall, discouraged, I met my friend.

"'How's the meeting,' he asked.

"'It's all over.'

"'What did you do?'

"'Unanimously elected the officers and adjourned,' I replied. 'I was the only person present.'"

"He laughed like the wild man of Borneo just come to town. But the disappointment didn't stop me. I got a president and vice-president by correspondence, and became secretary and treasurer myself and we carried on. That was less than three years ago. At the second meeting there were 20 people present, including a grower who had had long experience with bananas in the tropics. At the third meeting we had 50 people, and at the fifth meeting, last February, there were 400—and we expect 1000 Florida banana-growers next year."

The banana grows upon what appears to be a palm tree with a fleshy trunk, but it is really an herb, with most of its structure well below the ground. The bulbs, roots and rhizomes are out of sight, and the spectator sees only the leaves and leaf stems which, united, form a so-called "trunk." On that account, the banana in Florida can be frozen down to the ground with little damage—a well mulched plant, set deep, will live through temperatures below zero, sending up new shoots or suckers to bear within 12 months.

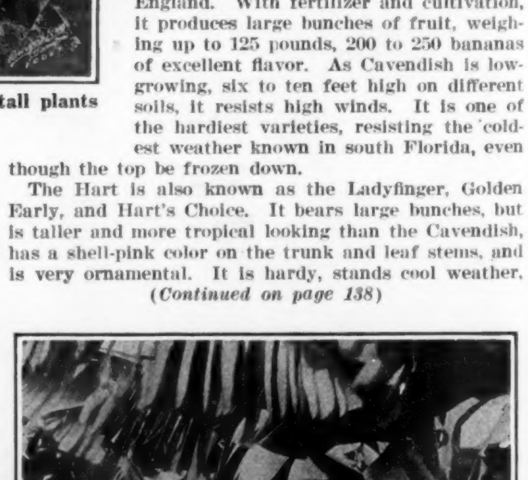
Because the forty-odd million bunches of bananas that we consume in this country every year have all come from the tropics, except a small local supply, this fruit is popularly thought of as something that could not be raised within our own borders. As a matter of fact, there are reasonable probabilities of growing bananas commercially not only in all Florida, but in southern Louisiana and southern Texas, and the plant can be made to fruit in southern Georgia and California. Bananas are grown for ornament, attaining nearly normal size without fruiting, as far north as North Carolina, and Bolles says the plant can be set outdoors in every northern State in May or June and, through cultivation and fertilization, brought to a height of 10 or 12 feet before frost comes. If the stalk is cut off after frost, and the roots covered with a thick blanket of earth, straw and packing, there is a good chance of carrying the roots through a northern winter. These plants, of course, are purely ornamental, bearing no fruit.

His experiments with a dozen different varieties indicate that three are best suited to Florida—the Cavendish, Hart and Orinoco.

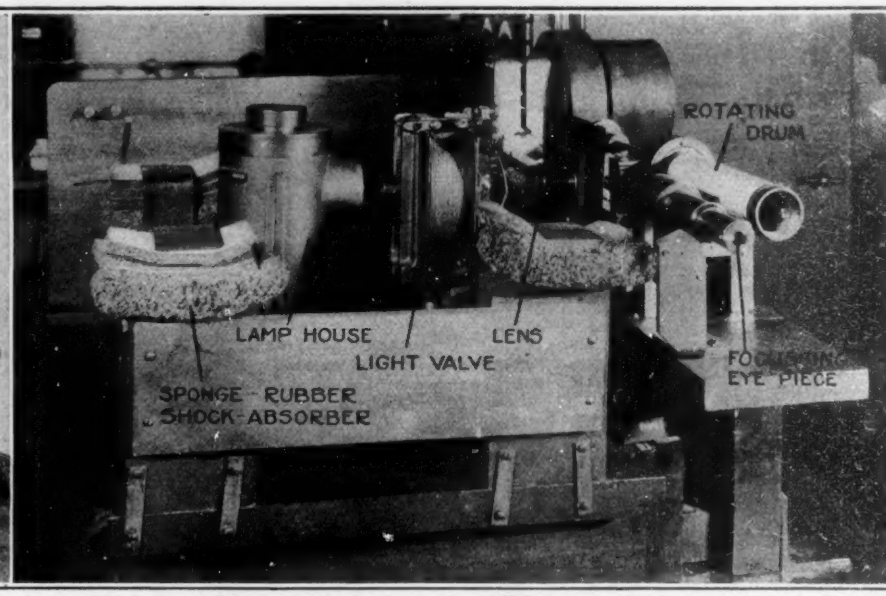
The Cavendish is sometimes called the Dwarf, Chinese or Canary Island banana, being the variety grown extensively in the Canary Islands for shipment to England. With fertilizer and cultivation, it produces large bunches of fruit, weighing up to 125 pounds, 200 to 250 bananas of excellent flavor. As Cavendish is low-growing, six to ten feet high on different soils, it resists high winds. It is one of the hardiest varieties, resisting the coldest weather known in south Florida, even though the top be frozen down.

The Hart is also known as the Ladyfinger, Golden Early, and Hart's Choice. It bears large bunches, but is taller and more tropical looking than the Cavendish, has a shell-pink color on the trunk and leaf stems, and is very ornamental. It is hardy, stands cool weather,

(*Continued on page 138*)



The dwarf Cavendish bananas growing near Tampa, the chief commercial variety in Florida's new industry



Left: General arrangement of the laboratory where "wired photographs" are received. At the right is the receiving apparatus in charge of a skilled operator. In the center background are the amplifier units and control board, with an engineer in charge. At the left are the developing, fixing and rinsing tanks for handling the received photographic images in the usual photographic style. ***Right:*** **Close-up view** of the receiving apparatus, with the various components labeled. Note that the light valve alters the beam of light passing through it from the lamp house to the sensitized film on the rotating drum, in accordance with the variations of the incoming current from the telephone line.

The latest addition to the news-gathering machinery of the age: telephoning press photographs

Telephoning Our Press Photographs

Ingenious and Practical System of Image Transmission Worked Out by Bell System Engineers

AN IMPORTANT achievement in the communication art was recently demonstrated by the American Telephone and Telegraph Company and the Western Electric Company. This was the transmission of pictures over telephone lines. On the afternoon of May 19, photographs taken in Cleveland, Ohio, were transmitted to New York and reproduced almost immediately. The actual time required to transmit a picture five by seven inches was less than five minutes.

The simplicity of this method is such that an ordinary positive film, which may be supplied by any commercial photographer, is used for transmission. A special apparatus makes an exact electrical copy of each element of area of the picture and transmits it over an ordinary telephone line. This electrical copy passes through the loading coils and vacuum tube repeaters placed in the line just as ordinary speech, and at the receiving end other apparatus reconstructs the picture. A telephone line may, therefore, convey intelligence to the sense of sight as well as to the sense of hearing.

The positive film, to which a picture has been transferred, is inserted in the transmitter simply by rolling it up in a cylindrical form. During the operation an intense beam of light is focused on the film as a tiny point. As the film is rotated under the beam of light exactly as a cylindrical phonograph record moves relative to the reproducer, the light passing through the film will vary in intensity according to the amount of blackening on the film. A photoelectric cell, which will be more fully described in a later paragraph, is placed in this transmitted beam and causes variations in an electric current. These variations follow exactly the variations in the light. Thus in a white part of a picture, as for example, a man's white collar, the light passes through with little loss and permits a comparatively strong current to flow through the photoelectric cell. Where the picture is dark, the light passing through is correspondingly decreased in intensity before it strikes the photoelectric cell, and the current is accordingly reduced. The feeble electric current produced by the photoelectric cell is first amplified by a direct-current vacuum tube amplifier and then, through the agency of a vacuum tube modulator, controls the current flowing out on the telephone line.

At the receiving end an unexposed photographic film is rotated under a focused beam of light in a manner similar to that at the transmitter. The two films—one at the transmitting end and one at the receiving end—are caused to rotate in unison by special regulating currents transmitted over the same telephone circuit as the picture. Currents coming in from the line vary the amount of light reaching the receiving film by means of a new device known as a light valve, thereby treating each element of this film to an exposure similar to that of the corresponding element of the film at the transmitter.

An essential feature of the transmitter is the photoelectric cell. It depends for its action on a phenomenon discovered by Heinrich Hertz in 1887. Hertz was also the discoverer of the electric waves which make radio possible. He observed that sparks could be more readily produced across the zinc spark gap used in his electrical wave researches when it was illuminated with certain kinds of light than when dark. Later it was discovered that this phenomenon is due to electrons emitted by the material used for the spark gap when excited by ultra-violet light, thereby making the atmosphere around it more conductive. The metals, sodium and potassium, exhibit this phenomenon when illuminated by visible light, while most other metals require ultra-violet light.

The photoelectric cell consists of two electrodes placed in an evacuated chamber. One of these electrodes may be constructed of sodium or potassium and the other may be of almost any other conducting material. When light falls upon the active electrode it will emit electrons into the evacuated space. If the second electrode is maintained at a positive

(Continued on page 139)

Typical "wired photograph" as received over the telephone line and reproduced here for magazine use. The photographic reproduction is in the form of a film negative, from which any number of prints may be made in the usual manner. The image is made up of helical lines on the film negative which is curved about a mandrel to form a cylinder, not unlike the old-time cylindrical phonograph record. The helical lines are of varying thickness, with the thickest parts to form the black portions of the image, and the thinnest parts to form the white portions. The reproduction here is by means of the line-cut engraving process

This photograph was taken in Cleveland and then sent over the telephone lines to New York City

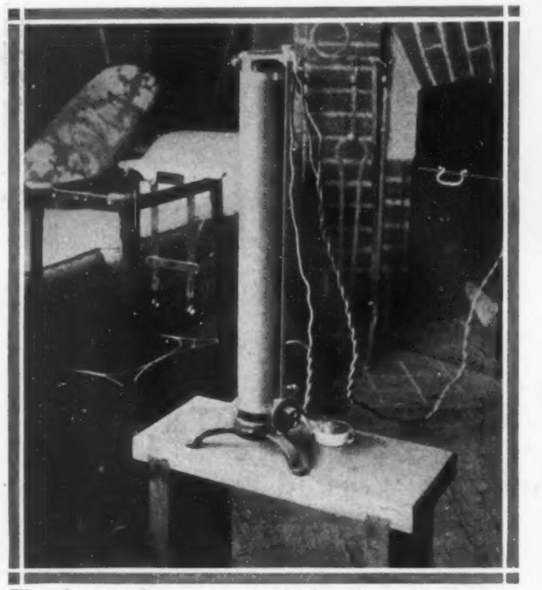
The "Margery" Mediumship—I

Describing Our First Test Sittings, and Explaining Our Program for the Immediate Future

By J. Malcolm Bird

Secretary to the SCIENTIFIC AMERICAN Committee on Psychic Investigation

MOST persistent among the criticisms of the SCIENTIFIC AMERICAN's work in the psychic field has been that we are hasty in dismissing our mediums. We have pronounced three cases to be fraudulent, having sat no more than five times with any of them. The spiritist has felt that sitting for our committee involves new and difficult conditions, to which the medium should be adjusted gradually over a long period. We retort that this argument implies a genuine medium whose initial performances in our presence are honest blanks, while to date we have had to deal only with active fraud. We have insisted that, with a candidate who does not try to trick us, we would sit indefinitely in the effort to build up whatever of atmosphere may be necessary for the production of genuine phenomena.



The rheostat by means of which it is made possible to have red light of any intensity, from zero to the full power of the lamp employed

This promise we have now reduced to performance. With the psychic introduced in our July issue under the pseudonym "Margery" our committee has had, up to June 4, 31 sittings—with more to come. Whatever our ultimate verdict, it will surely not be a hasty one.

I hope that those of my present readers who missed my July article will refer to it for the general facts of the mediumship. I repeat here only that FH is the medium's husband, and Chester her deceased brother who figures as her "control." This personality, if not actually Chester as it claims to be, must be either a genuine duality, a subconscious invention distinct from true duality, or an invention of conscious and fraudulent intent. Whatever is believed about him, one must be permitted to speak of him by name, to quote him, etc., without question.

Approaching the case so slowly, and importing new conditions as gradually as we can, it is no confession of weakness to say that all sittings have been held, to date, in Margery's house. The introduction of new apparatus, new procedures, new viewpoints and new sitters is sufficient demand for the present; we need raise the question of a new theatre only when the phenomena have become inescapably convincing in the old one. For the same reason, no effort is made, save at single seances, to exclude Margery's accustomed friendly sitters whose presence, however innocent we may be convinced it is, inevitably suggests the hypothesis of confederacy to the man from Seattle or Sydney. Like Margery and FH, these sitters appear pseudonymously in my tale.

In addition to actual committee members, and myself, we have had several sitters identifiable as "on our side." These include Mrs. McDougall and Mrs. Bird; Mr. Conant, Dr. Comstock's laboratory assistant; Miss Wood, his secretary; Dr. A. A. Roback, Harvard colleague of Dr. McDougall; and Mr. A. C. Lescarboura, our managing editor.

Margery, of course, is always present; save as noted, so is FH. Because he believes the phenomena to possess greater force under this arrangement, he rather insists on a place next the medium. The possibility of his being actually a co-medium seems sufficient to lead us to devise means of granting him the desired position. We achieve this by posting a committee sitter (usually myself) outside the circle, in the space between FH and Margery. The scout verifies that FH does not release Margery's hand, nor she his; he usually relieves them of the duty of mutual foot control; and he is left with one free hand to conduct any further exploration that may be necessary—the location of Margery's elbow or head, for instance, or examination of her chair.

We have sat with Margery on April 12, 18, 20, 22, 24 to 28 inclusive, May 8 to 19 inclusive, May 24, 25, 26, May 29 to June 4 inclusive. Dr. McDougall has been present nine times, Dr. Comstock 25 times, Dr. Carrington 17 times, Dr. Prince three times, Dr. Roback eight times, Mr. Lescarboura four times, and I 21 times. Six times FH has been the only non-committee sitter; twice we have had part of a sitting without him. Since we started, I have been a guest in the house for a total of 21 days, Dr. Carrington for 18 and Mr. Lescarboura for four. Mrs. Bird was in the house for ten days continuously, and naturally was much better able to check up on Margery's entire activity than any male guest. For hours at a time, Margery will be out and members of our committee in, unhampered. It seems obvious that, at the very least, no fraud requiring any large preparation could be maintained under such conditions.

Now the guilty person does not betray himself in his *every* act; nor does his *every* move stamp the innocent one as innocent. The procedures of fraud and innocence must in many details be identical; the investigator's task is to isolate the relatively rare facts that are actually inconsistent with the one hypothesis or with the other. To one who gives thought to this aspect of the matter, it will be evident that even though we suspect the psychic of no fraud, we must observe many things in the house, in the psychic's conduct, in the phenomena, which are *consistent with the idea of fraud*. To claim otherwise were the height of absurdity. It is, however within the facts to say that, despite our very wide opportunities for observation in and out of the seance room, we have as yet met no factor of the case that is *inconsistent with the hypothesis of genuine mediumship*. On the other hand, the manifestations have not yet occurred in our presence under full test conditions. But Margery seems to make progress toward rock-ribbed demonstration; so since neither her patience nor ours appears to approach exhaustion, we go right on with her.

For iron-clad proof of genuineness we should require but one type of manifestation, repeated often enough, under conditions sufficiently rigid and varied, to lend certainty that it is neither to be explained on normal grounds nor explained away. But not until the case is far advanced can we pursue such a single-track course; for only by much experiment can we determine which of Margery's phenomena are best adapted for final demonstration. We do not even know, initially, whether one of the spontaneous details will be available, or whether we shall have to invent apparatus for Chester to work with, and things for him to do.

At the present time the spontaneous side of the mediumship is open to the objection that it occurs only in total darkness. Originally, and for many months, Margery sat only in red light; but in the desire for actual materialization darkness was introduced. Although one is told that practically everything now produced used to come in good red light, Chester seems to have forgotten this. Pending a decision as to just what we may hope ultimately to make out of them, we may, of course, without prejudice or apology encourage the production of the spontaneous phenomena in the dark and observe them in the dark.

Our first committee seance, on April 12, was of interest here. Passing around from Margery's right, the circle included Dr. McDougall, "Robinson," "Smith," Mrs. McDougall, "Jones," FH and Margery again. Dr. McDougall had constant possession of the psychic's right hand and her two stockinged feet. I was in charge of the link between Margery and FH. My control here was unsatisfactory at first, not because of difficulties put in my way, but because I was experimenting. I perfected it in time to make all necessary observations. The only other person present was Dr. Roback, with a roving commission to wander about the room and discover or prevent fraud as he found himself able. It seems self-evident that the presence of such an observer, likely to bob up any moment at just the wrong place, would wreck the morale of any fraudulent operator.

The mercury-vapor lamp, supplied by Dr. Comstock's laboratory, which is used to give a source of light rich in ultraviolet, for the taking of seance photographs and for experiment with psychic photography

With both Margery's hands and feet firmly held as described, we got an extraordinary display of psychic lights. The range in brightness, size, location and movement was wide, though they were confined to the space within the circle. A puzzling feature of Margery's lights in general is that flashes described by some sitters as brilliant are invisible to others. This is not a function of particular sitters; the same light is often shown to some sitters, then withdrawn from their view and shown to the rest. This is not casual, but is done by intent and sometimes by announcement. We had it strongly on April 12th. If such lights are to be produced fraudulently, with the control we had, and without confederacy as we believe to be the case in this mediumship, something quite novel in the technique of trickery would apparently be required.

Ultimately Chester abandoned the lights and concentrated on the curtain pole, phosphorescent on both ends to mark its position. This pole was threaded through a maze of arms and legs in a path so complicated as, apparently, to present but two alternatives: either the pole must have been passed back and forth with great dexterity between two or more carriers as it proceeded, or its carriers must have been capable of penetrating matter. I use the word "carriers" as a generalization, avoiding the too material implications which would appear if I said "hands." It is impossible to describe this particular behavior of the pole, which has been noted in less degree on other occasions, in a manner as impressive as

the remarkable performance of this particular occasion.

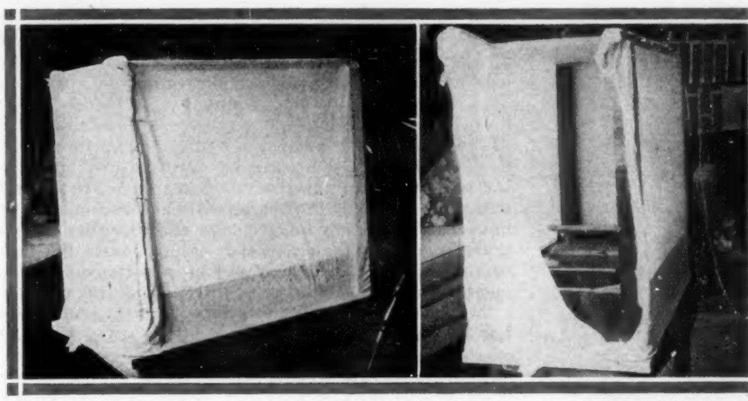
With complete check upon Margery's four extremities and FH's right hand, the cabinet was now opened out and thrown back on my side until I could no longer reach it with extended arm. It seemed absurd to credit Margery's head with such reach; certainly her arm did not move sufficiently to admit her elbow as the agent; no uncontrolled hand was near enough; no uncontrolled foot could have got past me. Then the table was capsized several times, winding up on end, with legs away from Margery. With no foot control around the circle this was not evidential, but there seemed no normal explanation for the behavior of the cabinet.

I may remark here that Chester seems to have much better success working on large, flat surfaces than on smaller ones or on delicate apparatus. This is in accordance with observations on other mediums (notably Palladino) with whom reasonable presumption of genuineness exists.

I sat down in the space vacated by the cabinet wall, and, still gripping Margery's and FH's joined hands with my right hand, I grasped his two ankles with my left hand. Dr. McDougall's complete control on his side was unchanged. The pole then went into action in the open space created by the retreat of the table. Numerous failures preceded a successful attempt to elevate one end of the pole to Dr. McDougall's knee, the pole tending to fall when half-way up. Then Dr. McDougall was told to hang on to this end with his knees. With his end thus pivoted, the other rose almost vertically, waved about in mid-air, caressed me under the chin, tapped gently the nest of three hands where I had control, etc. Jones, if his right hand were released by FH, could probably have done all this, so far as range of movement is concerned; but FH's acquiescence in fraud is one of the greatest improbabilities connected with the case. A foot, free in the theater of action, would doubtless have been equally effective; but when we ask "whose foot?" the position of the table rules out almost any answer that might be given. And whether we assume a hand or a foot, the accuracy of manipulation introduces difficulties which, I think, are *not* met by assuming that the phosphorescent pole-ends lighted up the scene sufficiently for the purpose. They certainly didn't illuminate it to me.

On May 14th, with no non-Committee sitters save FH, movement of the cabinet reached a climax. The circle (right to left, as always) included Margery, FH, Dr. Prince, Dr. Comstock, Dr. Carrington, Dr. McDougall, Margery. Controlling the hand link and FH's left foot, I was the only other person in the room. Dr. Prince had FH's right foot, Dr. McDougall Margery's two feet and one hand. After violent commotion by the cabinet we got brief red light for exploration. I found that while my wing had remained largely fixed, the other had swung far back and out. When he heard it going, Dr. McDougall had straightened Margery's arm out across her chest, putting her elbow effectively out of action and at the same time locating her head. In the darkness again, there came a crash; after which we got red light for a second inventory. Despite its great distance from Margery after the first chapter, we found the left wing now torn away and lying on the floor, with the rest of the structure erect. The screws that held the angle-irons on this corner had apparently been torn out, with splintering of the wood. In subsequent attempts, the destruction never went so far, nor were the conditions ever again so satisfactory; in particular, on two occasions it seemed as though the screws had been unscrewed instead of wrenched out, and once one might have been pardoned for inferring that this unscrewing had not taken place during the seance. But on the other hand, on June 4th, in the presence of Dr. Carrington, the cabinet was tilted over and tilted back in a way which no amount of experiment has been able to duplicate; pushing upon the cabinet invariably moves it backward bodily, instead of tilting it, unless it be held from the other side, at the base.

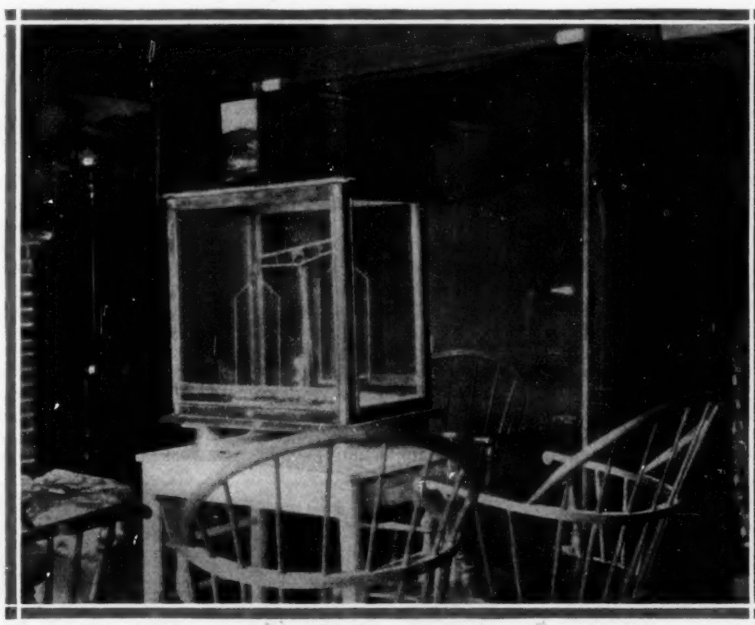
On April 26th, Margery had been distressingly ill all day, and we were most unwilling to have her sit. But she insisted that the plea of illness always was used against a medium, and that she *would* sit. She actually had to flee the room, to vomit, in the middle of the seance; nevertheless we got a good show. FH withdrew in the middle of the sitting, after which the circle ran Margery, Bird, Dr. Comstock, "Smith," Mrs. McDougall, "Jones," Dr. McDougall, Margery. With each non-Committee sitter surrounded, hand-control was perfect; no foot control was attempted other than of Margery.



Right: the muslin cage open, showing the contact apparatus; when the hinged boards are closed together, a buzzer in the box beneath will sound. *Left:* the muslin cage closed, in such fashion that the sound of the buzzer would be evidential of super-normal action

One of the things that the Committee has invented, giving the psychic power opportunity to operate in a region inaccessible to fraud

I was sitting with spread legs, a table leg in sharp contact with each thigh. It became evident to me that the table was struggling to tilt, away from the medium. I resisted, trying to learn the point of application of the force. It was too uniform to permit this observation; I felt prepared to entertain the theory that the impulse originated within the table. When I gave it free play, it speedily capsized the table, sending an array of breakable apparatus off to the floor—everything right side up, without damage.



The apparatus which has been on the table for earlier sittings—trumpet, ukulele, etc.—has been replaced by a large scales, made especially for the occasion and placed under a celluloid cage. As we go to press, it appears that the psychic power is making progress in the levitation of the unequally weighted pans of this balance. The stand in the corner at the left, behind the corner of the mantle, carries electrical connections for lamps, dictaphone, victrola, etc.; it was in this little corner that the "independent voice" seemed to be located. The cabinet is self-explanatory; but attention is called to the hinges in the center and the angle-irons on the corner

The arrangement of the cabinet, table, and chairs in which those comprising the circle are seated

This incident was repeated when FH was next absent, on May 11th. The circle was Margery, Dr. Carrington, "Smith," Bird, "Jones," Dr. McDougall, Margery; again the friendly sitters were surrounded, and this time we had foot control as well as hand control, all around the circle. Dr. Comstock was at liberty in the room, with several friendly sitters. The table tilted toward me, far enough to spill all the apparatus; we restored the *status quo* and again it tilted, all the way over. For inclusion in the minutes we all dictated specific statements regarding our control at the critical moments; these contained no reservations.

On May 12th, without any outstanding episode, we had a seance of high average. The circle comprised Margery, FH, Bird, "Smith," "Jones," Mrs. Bird, Dr. Carrington, Margery; no others were present. Objects were shoved about the table, and five sitters reported being touched. There were good lights, though few; and raps of three distinct sorts, in various places, though never remote from all sitters. Vocal sounds came from high in the cabinet and even from outside it, and there was a little trumpet voice. We got simultaneous movement from the ukulele and the scales, both unmistakable, at widely separate points.

On May 13th, the circle included Margery, FH, "Mrs. Gray," "Smith," "Gray," Dr. Carrington, "Jones," Dr. Prince, Margery. Gray, by the way, is a person whose scientific research has given him a place in "Who's Who," and the idea of his fraud is pretty far-fetched. Indeed, with small exception, much the same may be said of Margery's accustomed sitters; they are by no means the nondescript outfit which might be imagined, but very substantial people of affairs, both materially and intellectually. Nevertheless, in charge of the link at Margery's right, I paid due attention to the necessity for insulating her against the concentration of friendly sitters in that quarter.

The ukulele was on the shelf under the table, initially; it was got off this and on the floor, off the floor and on the table, off the table and cuddled into Dr. Prince's arms like a psychic baby. The attempt to raise it to the table-top involved preliminary failures, the instrument falling just as did the pole on April 12th. At the end I sat in Margery's chair, and experimented with my feet in the dark. The fact that I scored a very much more conspicuous success than I or anybody else expected, would be more applicable had we not been pretty sure that the ukulele did its climbing at Margery's end of the table, where Dr. Prince's expert control was operative.

At this sitting we got movement by the curtain pole of a sufficiently impressive character to lead Dr. Prince to question my statement of control; and we had to get Chester's permission for a moment of red light, while he verified that I had the command of the situation which I had claimed. I could not blame him for his incredulity; the statement that I had control of four hands and two feet pertaining to three different people, must have struck him as pretty sanguine.

During this sitting, whistling in the cabinet coincided, more often than I have observed on any other occasion, with manipulation of pole and other objects outside. If this were the only case of the sort, I suppose we ought to incline toward confederacy as the explanation; but it is far from alone. Enough of this sort of thing, under adequate conditions, would obviously establish the mediumship, by driving the skeptic to choose between the independence of the voice and the independence of the other manifestation!

After numerous defaults on his promises, Chester chose the evening of May 19th, for a special demonstration of the independent voice. The circle comprised Margery, FH, "Miller," "Mrs. Miller," Dr. Carrington, Margery; I was in control of the hand link and nobody else was present. The door was barricaded with couch and curtains, in a way that prevents one from entering in the dark without a lot of commotion. Control of Margery's mouth was with my hand, of Mrs. Miller's by Dr. Carrington's hand; of FH's by my ear very close to his face. For control of Miller's mouth we are forced to rely upon statements by FH and Mrs. Miller.

The alleged independent sounds heard included three clear whistles and five whispered "hello's. By a system of silent signals we established that, while nobody save FH and I heard them all, each of them was heard by some third auditor. The judgment of all sitters except

(Continued on page 132)

Making a Monument Out of a Mountain

Stone Mountain Memorial—Greatest Work of Sculpture in History

The head of General Lee, with the sculptor, Gutzon Borglum shown to the same scale

WHAT follows is the story of the largest piece of sculpture ever attempted in ancient or modern times. The work is known as the "Stone Mountain Commemorative Memorial," and it is located in the State of Georgia, 16 miles from Atlanta. Before describing this unique work in any of its details, let us answer the questions: What is Stone Mountain?; and, what is this vast work which is being cut deeply into its face as a memorial for endless ages to come?

Stone Mountain is a vast block or cliff of pure granite, one and one-half miles in length, which rises from the valley to a height, throughout its central portion, of 867 feet above the ground. For several hundred feet this imposing and absolutely solid wall rises perpendicularly, and then for the few hundred feet remaining, curves over backward gradually to its highest point. For the reason that the memorial is intended not merely for a present but for a future tribute to the men who fought in the southern confederacy, the first step was to determine the quality of the granite and whether it possessed sufficient durability to make certain that it would stand in all its clear-cut outline for centuries to come. A careful examination of the stone was, therefore, made to a depth of ten feet from its surface; and the State geologist, after thorough analysis, reported that its erosion takes place at the rate of only one inch in 100,000 years. The granite is in color a very beautiful plum-gray with a slight rose tone, and although it is, of course, harder, it cuts like marble.

The Stone Mountain Commemorative Memorial has grown to its present magnificent proportions from a comparatively modest beginning. If you ask Gutzon Borglum, the sculptor, he will tell you that a momentary flash of inspiration was responsible for a work which will take eight years to complete. It seems that several years ago, the United Daughters of the Confederacy inaugurated a movement for a memorial to Robert Lee as the representative of the South. Their plan was for a bas-relief head of Lee to be cut in the base of Stone Mountain. Borglum pointed out that such a work would be without distinction or dignity, since it would be utterly dwarfed by the mountain. He likened the plan to pasting a postage stamp on a barn door. This discussion occurred during a meeting with the southern women in the valley in front of the mountain, and the sculptor was asked what he could offer in exchange for their scheme. He said that they should grave something of heroic size deeply across the face of the mountain, which should be a portrayal of the mental and physical energy of the South during the war.

"As I stood there in the sunset, I could almost see Lee and his army moving, as if alive, across the face of the mountain." The design was at once adopted, and the southern women threw themselves into the work of securing the necessary funds. This work they have done so well that success is assured.

Borglum's design shows the Confederate army on the march, with a central group consisting of Lee, Davis, Jackson, Johnston, Forrest and Stewart. All branches of the service are in that long line, which stretches 200 feet in depth and between 1200 and 1300 feet in length across the vertical face of the mountain at a little above its mid-height. There will be a full quarter of a mile of marching figures.

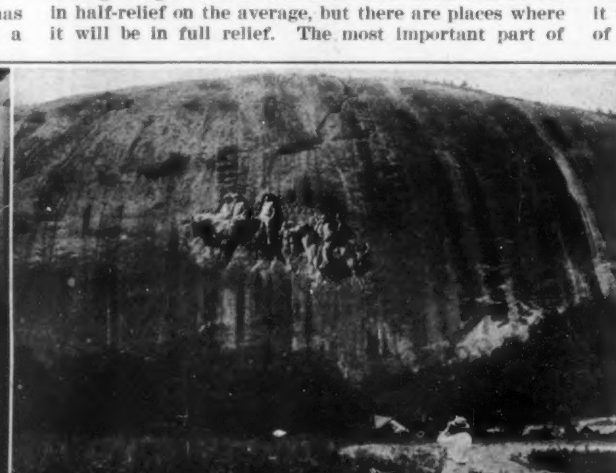
The original estimate for the cost of the memorial, as made in 1916, was $2,000,000, but due to the increased cost of labor and materials it will probably reach $4,000,000. The expense is to be borne by private subscriptions; by the city of Atlanta, Fulton County, and a contribution from the State of Georgia. Other sources of funds will be tablets to be placed on the walls of the memorial hall which, like the rock tombs of antiquity, will be carved out of the solid granite of the mountain at the valley level. This hall will be 300 feet long, 50 feet wide, and 45 feet in height to its ceiling. It will follow the Doric style of architecture, and in fact will be a modern rock temple. In the front, it will be lighted by 13 windows for the 13 States.

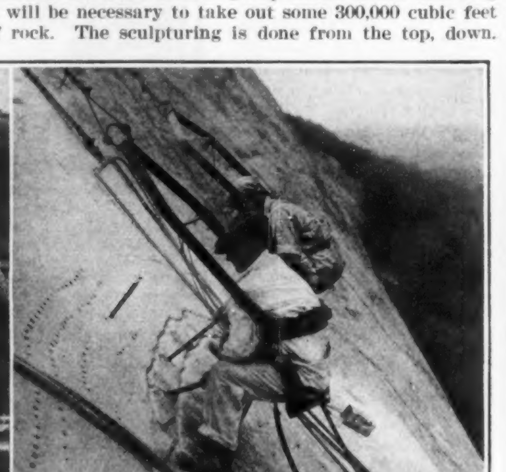
The best way to sense the immensity of this memorial is by comparison with other large sculptural and structural works of ancient and modern times. Thus the great Sphinx of Gizah would sink out of sight behind General Lee's head; the far-famed Colossi of Memnon at Thebes would scarcely reach to his stirrup; and if the base of a 16-story skyscraper stood at the level of the hoofs of General Lee's horse, its top-most cornice would just reach the top of his hat; for Lee and his horse occupy over 200 feet of the vertical face of the mountain. The marching host will stretch across the mountain's face from southwest to northeast, and in the whole group there will be about 1000 figures whose average height will be 140 feet. The work will be cut in half-relief on the average, but there are places where it will be in full relief. The most important part of the frieze will, of course, be the central group of General Lee and his officers. General Lee's head has been completed and was unveiled some months ago, and it is estimated that to finish this central group, as it is shown in one of the accompanying illustrations, will take about three years of work. The cutting into the rock is about 21 feet deep back of General Lee's horse. As an impressive evidence of the magnitude of this sculpture, it may be mentioned that, at a luncheon given in connection with the unveiling, 30 people sat down on Lee's shoulder, where a canvas enclosure gave shelter to the guests, who thus sat on the edge of a precipice which dropped some 500 feet below them. In tackling this stupendous work of sculpture, which in point of magnitude was altogether without precedent, it was evident at once that it could not be attacked from below. The approach to the face of the cliff would have to be from above, not from below.

The first step was to send workmen down over the curved upper face of the rock in slings; from which they drilled holes and fixed iron bars firmly in place. Upon these a wooden stairway was constructed over the out-curving upper face of the mountain, and from this point downward the making of the drawing upon the rock and the subsequent sculpturing were done by men who were lowered in specially constructed steel chairs (bosun chairs they would be called aboard ship) suspended from above by half-inch steel cables, as shown in one of our illustrations.

In carrying out the work, problems came quick and fast, and the first of these was to get the outline of these huge figures correctly drawn upon the face of the mountain. For this purpose a large projector, herewith illustrated, was built and housed in an operating shed. Then Mr. Borglum made a slide of the central group of generals and on the first dark clear night projected the slide upon the mountain. As viewed from the valley below, it stood out with wonderful clarity of definition, and men were sent down in their chairs to paint in the picture thus represented. When they reached the picture, they telephoned down that what seemed so sharp down there, 1200 feet away, was visible to them slung on the mountain side merely as very indefinite graduations of shading; in other words it was impossible for them to paint in what they saw. Mr. Borglum then made a line drawing of the photograph and this, when projected, showed up with great distinctness and the men were able to paint in the outlines with white paint. The foreshortening, due to the angle of incidence of the rays on the mountain was overcome by tilting the slide in the projector.

The cutting out of the rock will be no small task; for it will be understood that blasting is out of the question, because of the danger of shattering the rock and breaking away needed material. The work is being done by drilling holes in rows which are about six inches apart; the holes being four inches from center to center in each line. After drilling, the holes are connected with a cutting tool and the stone is wedged out. The quantity of excavation runs to great figures. Thus in the main central group which is 330 feet long it will be necessary to take out some 300,000 cubic feet of rock. The sculpturing is done from the top, down.





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The projector, specially designed for the purpose, with which the drawing of the central group was thrown upon the mountain

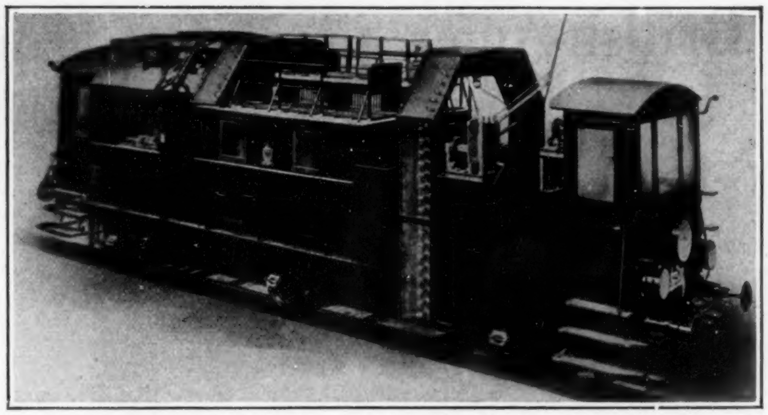
The perpendicular face of Stone Mountain, 867 ft. high, with Lee, Davis and Jackson, shown as they will appear when the work is completed

Drillers, suspended in chairs, cutting out the hat of General Lee, 500 feet above the surface of the valley below

A Car for Examining Tunnels

RAILWAY tunnels must be examined from time to time in order to see whether there are loose stones which can fall down on the trains, water which drops down, or other obstacles which later may get dangerous. These examinations are usually made by walking through the tunnel and lighting up its walls with acetylene lanterns carried in the hands. This method takes much time and is not at all reliable. Therefore there has been constructed in Germany a special railway carriage for examining tunnels which is fitted as well for common railways, when it can be hauled by a locomotive, as for electrical ones, where it is self-contained. On both ends the carriage contains cabins for the driver, who regulates the velocity in the usual manner by handling an electrical controller. Behind the front end there is arranged the usual apparatus for taking off the current from the line. Then follows a frame containing 54 incandescent lamps sitting on a reflecting surface. By these lamps the walls and the ceiling of the tunnel are lighted up thoroughly so that every detail easily can be observed.

Behind the frame on the deck of the car are seats, on which the officials and workmen stand. The officials observe the walls and the workmen make instantly smaller repairs. Behind these seats there is a second smaller frame with lamps the light of which is reflected against the ceiling, so that there is a high degree of brightness on this important part of the tunnel. The inner-part of the carriage contains the storage battery, tools, measuring instruments and all the other things which are necessary to make the work successful. The tunnel-inspection car, we are informed, has come into quite general use on the German railroads, and it looks like something that might profitably be imitated on our own lines.

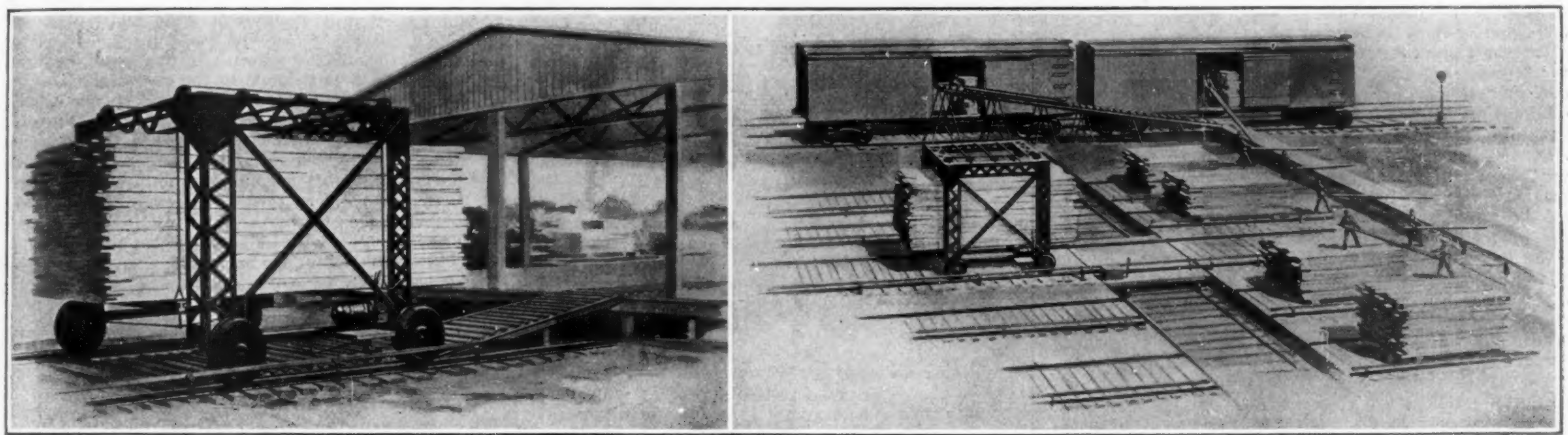


The special car that takes the track-walker out of the tunnel and does his work better than he could do it himself

Increasing the Potato Yield

THAT two crops of potatoes can be grown where only one grew before has been shown by a discovery made by Professor J. T. Rosa of the University of California. The difficulty in sections where two crops are otherwise possible has been that the seed potatoes from the first crop must be seasoned three or four months before planting if they are to sprout readily.

Professor Rosa has found that if the new seed potatoes are cut up in the usual way for planting and then dipped into a weak solution of nitrate of soda for from thirty minutes to an hour a short time before they are put into the ground, they will sprout as quickly as seasoned seed. The common fertilizer grade of nitrate of soda can be used at the rate of three and a half pounds to ten gallons of water, and as the solution may be used repeatedly the cost is very small. In an experiment started February 23, 1923, seed potatoes treated by this method came up quickly and gave practically a 100 per cent stand by April 3, while untreated seed came up much more slowly and did not show a full stand until April 21, nearly three weeks later. It was found that the treatment was useless unless the tubers were cut before dipping in the solution. Besides enabling the potato grower to use his early crop potatoes to plant a fall crop and thus get two crops in one year on the same land, Professor Rosa believes that the new treatment will enable growers to mature their early crop still earlier than at present, and thus get the benefit of the higher prices that usually prevail for early potatoes. It may be entirely possible, he says, to make important potato States like New Jersey, Virginia, the Carolinas, Florida and California independent of the more northern States, from which they usually obtain most of their seed potatoes for planting; and it should be possible to get extra early crops of potatoes in States that now must import their first supply.—*Abstract from Science for October 12, 1923.*



Close-up view of the latest wrinkle in handling lumber, and general lay-out under which it works, showing how carefully the details of this industry must be handled to conserve the profits

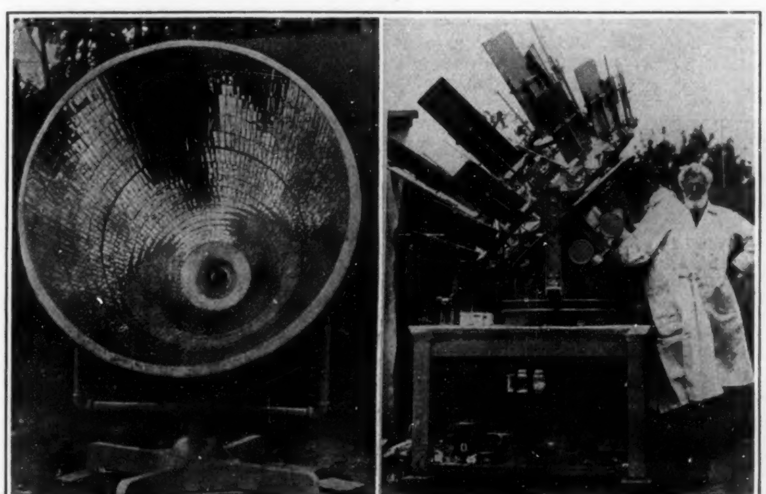
Handling Lumber in a Hurry

CONSERVATION and production principles, which have resulted in the company's actually being able to deliver to automobile manufacturers completed loading devices at approximately the same cost as the manufacturer himself can buy raw lumber, have been strikingly carried out in the Jackson, Miss., plant of the concern that supplies most of the loading devices for automobile shipments. A cost-saving machine, new alike to the lumber and automotive industries, has been devised which materially decreases the expense of handling lumber. This machine, a combination electric hoist and conveyor, picks up and transports at one operation 15 tons of lumber—the equivalent of a half carload.

The top part of this machine, which is of structural steel, looks like an inverted letter U. The machine, which secures its operating power from a third rail, is run over the lumber pile until this inverted U is squarely over it. The I-beam attachment on the hoist is then run under the pile and fastened on the other side. By means of the conveyor and a transfer car the lumber is carried to its proper place and deposited to await manufacture.

So efficiently have operations been worked out at this newest mill that 95 per cent of the lumber received is being put to productive use. The other five per cent is sold for crating. Bark, sawdust and low grade pieces are utilized as fuel to provide operating power, so that no part of the tree fails to find useful application.

Four carloads of raw lumber can be unloaded at one time on to a moving table, where it is marked according to grades. As his particular grade comes to each sorter he piles it up alongside him. When his pile has grown to sufficient size, the hoist and conveyor pick it up and carry it away to be manufactured. The machine is 14 feet long and 15 feet wide. It runs on a track 10 feet wide, as does the transfer car. It looks as though it were capable of being applied to many other industries than the one in which it originated.



The latest design in sun mirrors for concentrating the energy of the solar radiation and making it available to do useful work

Another Sun-Power Furnace

ATTEMPTS to harness the heat of the sun and make it do the daily tasks of the human race are nothing new. The annexed photographs illustrate the latest, and one rather more promising than the general run of inventions in this field. Marcel Moreau, Jr., of San Francisco, is the inventor of this curious combination of multiple mirrors employed to concentrate the sun's rays to a focal point. It will be realized that the assembly shown is equally effective, whether the separate mirrors be joined up in a finished parabola as at the left, or simply brought together in proper relation as at the right. The inventor claims a temperature of 15,000 degrees at the focus of his mirror. No statement is made as to the fashion in which he recovers and applies the energy thus concentrated. We infer that he follows the current vogue in solar-furnace design by having it heat and set up circulation in a body of oil.

The British-American Cup Contest

An International Trophy Which Promises to Rival the America's Cup in Interest

THE most famous of all yachting contests is, of course, that which has been held at intervals during the past 70 years for the America's cup. Since this most famous of all schooners won the Royal Yacht Squadron's trophy at Cowes and it was handed over to the New York Yacht Club as a cup to be contested for in international races between yachts of large size, there have been no less than 13 efforts on the part of British yachtsmen to win it back, the last four of these having been made by Sir Thomas Lipton. It begins to look as though even that persevering yachtsman and his advisors have come to the conclusion that, under existing conditions, the chances of winning the "America's" cup are too small to justify the great expense and trouble of another contest. Fortunately, the interest in international competition has been transferred from the big 90- and 75-footers to the small boats of what is known as the six-meter type. These, as developed under the international rule, are of about the same size and speed as the famous knockabouts of the early years of the present century. In dimensions they will run from 18 to 24 feet in length on the waterline, with about 7 feet of beam, a draft of about 5 feet, and a displacement of 8000 to 9000 pounds; the sail area being 500 square feet or something less.

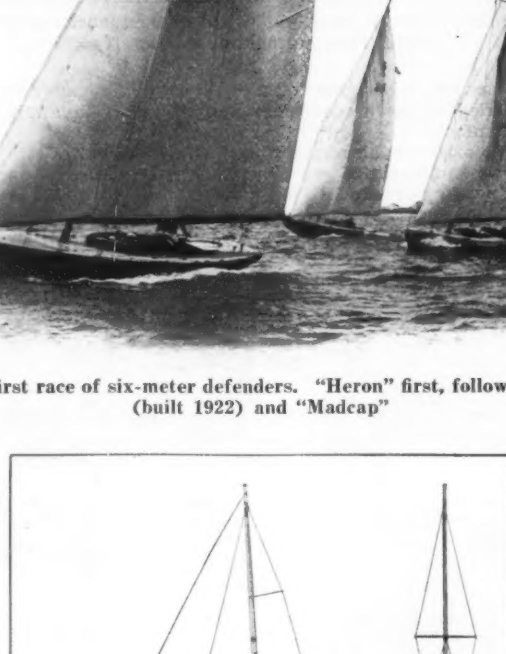
Finish of first race of six-meter defenders. "Heron" first, followed by "Lea" (built 1922) and "Madcap"

International competition in the days of the 90-footers was a rich man's sport; the cost of building, tuning up and racing one of these yachts running to several hundred thousand dollars. Today, however, the sport of yacht sailing has become greatly extended, particularly in the smaller classes; for, in spite of the recent increase in the cost of materials and labor, the building and racing of six-meter boats is not beyond the purse of a man of moderate means. Hence, instead of present-day international contests resulting in the building of two or three boats of which two only are selected, the six-meter contests produce each year on both sides of the Atlantic a fleet of small boats, from which eight are selected, four representing the challengers and four the defenders, for the series of contests. This results in a large number of regattas throughout the yachting season, first, for the selection of the representative boats and lastly for the cup races themselves. The activity in America may be judged from the fact that 18 boats are available this season for the elimination trials, and of these eight are new craft built during the spring of this year. The British have built even more extensively than we; for there are nearly 40 six-meter boats afloat in British waters.

The international rule, under which these little boats are built, was designed to produce a wholesome racing yacht which would be fast enough for good racing sport and sufficiently wholesome in design and strength of structure to provide a good cruising boat, serviceable for many years. Under the old rule, which placed a penalty only upon waterline length and sail area, yacht designers gradually developed a boat of great beam, long overhang forward and aft, a shallow body, a deep keel with heavy outside lead ballast, and an enormous sailspread—the idea being to produce a hull which, when heeled, would have a long immersed sailing length, and sufficient power to carry an exaggerated area of sail. Thus, "Reliance," on a 90-foot waterline, was over 140 feet long on deck, 26 feet in beam, with nearly 20 feet of draft, and swung about 100 tons of lead ballast below with 16,000 square feet of sail aloft.

The International rule and our own America's cup contest rule have done away with these exaggerations. The shallow deep-keel boat gave place, in the "Resolute" of the last contest, to as sweetly modeled a craft as one could wish to see; and in the little six-meter boats, the International rule has had the effect of producing a large fleet of fast and able yachts, which have all the good qualities which were noticeable in "Resolute" and some qualities in which they are better than "Resolute."

Through the courtesy of H. J. Gielow, Inc., we are able to present a profile, deck plan, and sail and spar plan of the "Paumonok," built by Lawley of Boston to the designs of the Gielow company.



Sail and span plan of "Paumonok"; a Gielow boat of 1924. Note the trussing of the lofty mast

The launch of the Hoyt six-meter boat "Madcap" (1924) at Nevin's Yard City Island

At first sight she looks very much like the famous "Lea," a boat by the same firm which proved to be the best of the American craft built for the 1922 contest. But there are points of difference as can be seen from the following table:

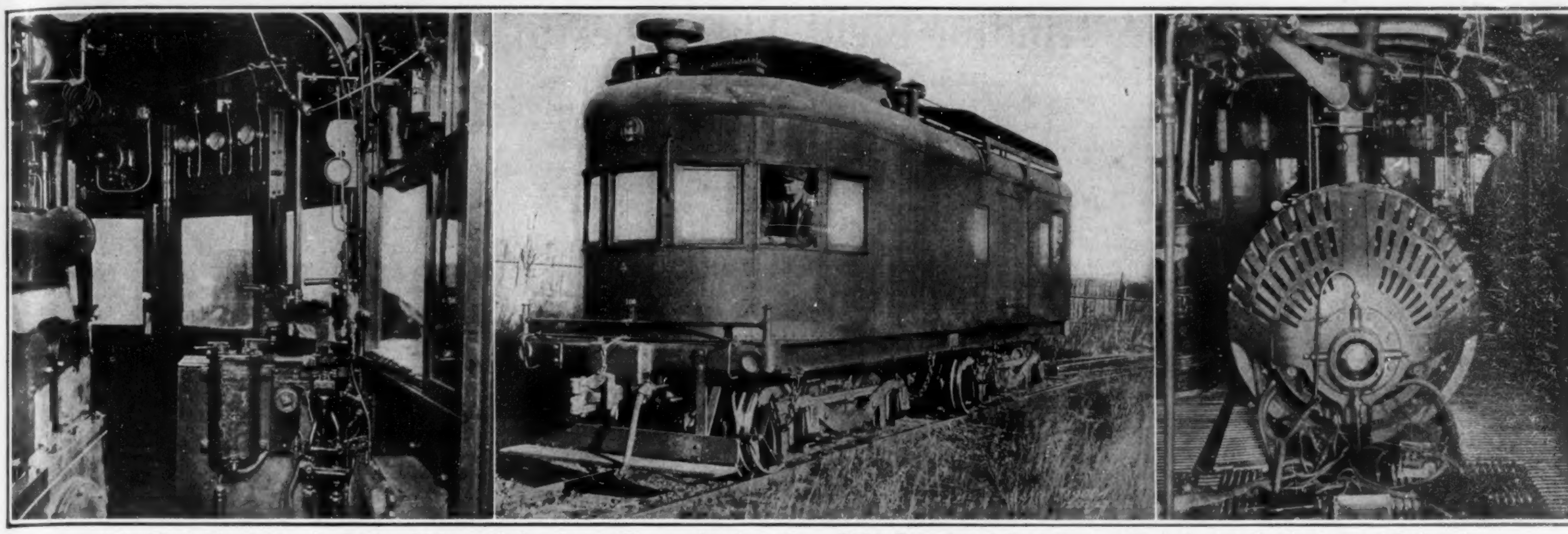
	"Lea"	"Paumonok"
Length over all......	31 ft. 0 in.	31 ft. 9 in.
Length on L. W. L...	22 ft. 9 in.	22 ft. 0 in.
Beam extreme	6 ft. 8 in.	7 ft. 0 in.
Draft	5 ft. 3 in.	5 ft. 0 in.

In the four series of races which have already been held for the British-American cup, two have been won by the British and two by the Americans; and it is a very suggestive fact that each nation has won the series of races that has been held in its home waters, America being victorious on the Sound and Great Britain in the Solent. Why should this be? The first thought that comes to one's mind is that there must be something in the knowledge of local waters, currents, etc., which makes the difference, together with the fact that a man will presumably do better among his own people and amid familiar surroundings. Well, this may have something to do with the matter but not very much. The explanation is to be found in the widely different wind and water conditions in the Sound and the Solent during the summer season. In the Sound, as many yachtsmen know to their cost, the average summer winds are light and uncertain, and during a race will sometimes die out altogether, whereas the average Solent winds are strong and can generally be depended upon to hold true during a race. Hence and very naturally, the local designers and builders turn out a type of boat most suitable to their own prevailing weather conditions. The English build a boat that is longer over all, with easy lines suitable to driving at high speed in fresh breezes, and because they can depend upon having plenty of wind, they carry a rather small sailspread above a light and easily-driven hull. American designers, on the contrary, design their boats for light weather conditions; they are of larger displacement with larger sail area, a deeper mid-section, and shorter ends. The wetted surface is relatively small and since small wetted surface combined with large sail area means speed, it follows that in American waters the boats can beat the British whereas in British waters where the winds are strong and the speeds are high, the British, with their greater length and rather finer hulls show to better advantage.

Motion Pictures of Atoms

MOTION picture photographs of the tracks of the nucleus of the helium atom traveling at a rate fifteen thousand times greater than that of the fastest rifle bullet were recently exhibited to the American Association for the Advancement of Science by Professor W. D. Harkins, of the University of Chicago.

One of the forty thousand photographs taken in the course of Professor Harkins investigations showed the collision of the nucleus of a helium atom moving at this speed with the nucleus of an argon atom which is much heavier. The force of this blow was the most terrific ever recorded by any direct experimental means, since the energy of this helium projectile, on account of its immense velocity, is some two hundred and twenty-five million times that of a rifle bullet in proportion to its mass. Nevertheless the argon nucleus is not broken by the shock, for its track beyond the site of the collision is found to be, not double, but single. The nucleus is the "central sun" around which the planetary electrons revolve at high speed. Although the nucleus of an atom is so small that it would take a million times a million of them laid in a row to reach an inch, their motion can be made visible and photographed by passing them through damp air strongly lighted from the side. When the air is suddenly cooled by expansion, the flying atomic fragments leave luminous tracks of condensed water vapor. Ordinarily the path is straight, but some of the photographs show that the helium nucleus has been deflected by contact with the nucleus of an atom of gas.



Left: The inside of the cab, showing driving controls. *Center:* The complete locomotive. *Right:* Rear view of the generator unit; in front is the direct-connected oil engine

Applying oil fuel to the generation of electric-locomotive power

The Oil-Electric Locomotive

A NEW type of electric locomotive, using oil for its fuel, the first of its kind ever manufactured in America, has been especially designed for switching service and is being given its first practical test by the New York Central in its freight yards. The power-plant equipment consists of a 300-horsepower oil engine, directly connected to a 200-kilowatt generator. The motive power consists of four motors, one of which is geared to each of the four axles. The unit has a total weight of 60 tons, all on the drivers.

There has been extensive experience during the last 15 years in the construction of self-propelled motor cars and locomotives using gasoline as fuel. About 90 equipments have been put into service during this period and most of them are still operating. In order to take advantage of a low-priced fuel in the internal combustion engine, an arrangement was made to build an engine designed for the use of fuel oil and having the characteristics of speed and weight that would be suitable for its use in a locomotive. The complete unit is, therefore, a combination of pieces of apparatus all of which are well tried and whose combination promises to result in a degree of fuel economy which is far in advance of anything that can be attained by the steam locomotive. The locomotive has been in use in the yards of the oil-engine factory at Phillipsburg, N. J., for about four months.

The primary unit is a six-cylinder engine designed to burn fuel oil and having the features of the well-known Price system of direct fuel injection. This system avoids the use of high pressure injection and also effects a reduction in weight, an improvement in mechanical efficiency and an increased simplicity and reliability. The fuel is injected into the various cylinders through a distributor by means of a single-acting plunger-type pump. The lubricating system is of the continuous filtration type by means of which the oil is returned from a crank case through an oil filter before returning to the system again.

All parts of the cylinders, cylinder heads and combustion chambers are water cooled by means of a thermostatically controlled water supply. The water from these water jackets passes to a radiator located on the roof and a thermostat maintains an even temperature regardless of weather conditions. Sufficient fuel can be carried for 48 hours' continuous switching service. The muffler for reducing the noise of the exhaust is also mounted on the roof.

Due to its high economy (about 0.43 pounds of fuel oil per brake horsepower) the engine is free from smoke which renders it particularly suitable for service in cities or in places where smoke is objectionable. As ordinarily used in switching service, the 60-ton locomotive consumed about 20 to 26 cents worth of fuel oil per hour.

The unusual feature of this design is the use of a direct-current generator supplying current to the motors without intervening accelerating resistances. This is accomplished by using a differential series field on the exciter, which automatically reduces the generator voltage with the increase in the amount of current drawn by the motors. The speed of the locomotive therefore automatically increases as the load is reduced, corresponding to the rise in impressed voltage. This control completely eliminates the possibility of overloading the generator or motors or of stalling the engine.

The control is so arranged that the opening of the throttle by moving the control lever increases the engine speed and at the same time energizes the exciter field which in turn energizes the generator field. The generator current passes through a differentially wound series field to the driving motors and being opposed to the separately excited field lowers the generator voltage in proportion to the load. As the locomotive accelerates, the current passing through the differential series field is gradually reduced, the generator voltage automatically increases and speeds up the locomotive. The main excitation of the exciter field is furnished by a storage battery which also supplies control current and locomotive lights.

The Kinetic Atom

THE steps by which the nuclear atom was established are of much interest. Rutherford was bombarding atoms by the alpha particles projected with known velocities from a deposit of radium C. He has carried out such bombardment many times since, sometimes with surprising and exciting results. But this time he was merely driving the particles through matter and catching them on a fluorescent screen, so as to see how many had been scattered or deflected from their original path, and by how much. If the atoms consisted of a nucleus surrounded by electrons, at planetary distances in proportion to their size, the atom would be as porous as a solar system, and the alpha particles could be trusted to go through it, for the most part, without perceptible perturbation. Some of the electrons might be knocked out, and so the atom become ionized; but the massive alpha particle would take scarcely any notice of minor obstructions, and would proceed untroubled on its way, until it encountered or came exceedingly close to a central nucleus, of mass greater than itself. Such an occurrence would be comparatively rare. Judging by the probable size of the nucleus on this theory, it would not occur more often than 1 in 10,000 times—probably not so often.

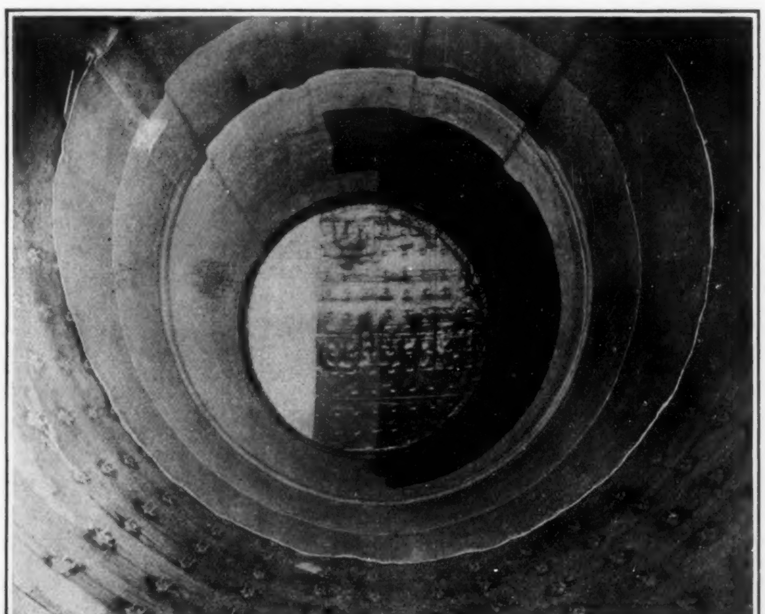
The circumstances of such an encounter, whenever it did occur, are amenable to ordinary and, so to speak, elementary dynamical considerations, if the law of inverse square holds good. Accordingly, it was possible to deduce beforehand what would happen in all the likely kinds of collisions—if they can be called collisions where there is no contact. The law of probability could be applied to determine the number of scatterings in each direction; and then, by the aid of Crookes's fluorescent zinc sulfide screen, on which the splashes or flashes caused by the impact of the deflected alpha particles could be seen, the number scattered in any direction by the atoms of a given substance could be counted and compared with theory. The central solid compact nucleus was established as a reality, and a proof was forthcoming that it exerted force, even in its immediate neighborhood, as the inverse square of the distance; and it was established that astronomical laws still hold good, even in the hopelessly ultra-microscopic region in the interior of atoms.

Rubber-Lined Tanks for Carrying Acids

THE usage of acids in the various chemical industries has increased to such proportions, that a more efficient method of shipment is very desirable. It is possible to ship concentrated sulfuric acid in iron tank cars but dilute sulfuric, hydrochloric, tannic and phosphoric acids cannot be shipped in this manner unless the tank car is lined with special metal or other acid resisting materials.

This need has now been met. A large rubber company of Akron, Ohio, has developed a process whereby an acid resisting rubber compound can be vulcanized to the inside walls of tank cars as they stand on the track. This process is equally applicable to large stationary storage tanks. Anchoring devices are secured to the inner surface of the tank spaced at a desired distance apart, approximately one foot, and over these members the acid-proof lining is laid down.

The first coating consists of a rubber covered wire screen which is applied to the surface of the tank allowing the anchoring devices to pierce the screen and clinch on the opposite side which rigidly holds this base coating to the walls of the tank. Several layers of special compounded rubber are applied on this base coating, completely covering the entire surface of the tank and vulcanized thereon rendering the walls of the tank absolutely acid proof. It is expected that acid of any sort may be shipped with impunity in these containers.



Sectional view illustrating the method of lining acid-carrying tanks with rubber

A Landing-Field That Goes to Sea

FOR those who are interested in the development of modern aviation science, the U. S. S. "Langley" presents a most fascinating departure from the commonplace. From the standpoint of appearance, operations, or pure science, she has a strong appeal that has not failed to attract the attention of thousands of visitors wherever she has gone.

Some years back, even before the beginning of the World War, there had been conceived the possibility of flying aircraft from and on to ships. This idea was not given much publicity at the time, both because nothing concrete was developed and because the world at large, being little acquainted with ships, would probably have ridiculed the idea as a useless risk to human life. But experiments were carried out after months of preparation, in many cases before a single flight was made. The first catapult was a primitive impractical looking affair which would have rivalled the appearance of the first "Flivver." Not only was the appearance of this mechanism against it, but it was none too safe.

Before the World War our naval aviators consisted of a very small but intrepid nucleus who were destined to bring to light many surprising innovations in the art of aviation. They were then as now, line officers detailed at their own request to aviation duty. The fascination of the duty is best shown by the fact that most of them "stuck" and are still with it. They had dreamed of an aviation ship for many years before their dream came true; they had undertaken many hazardous flights; they had fought battles harder to them than they were to wage in actual warfare—those against the elements of nature rather than against an enemy of known strength and endurance. That they won was due to the faith in their weapon of warfare as well as to an indomitable perseverance which could not fail.

It is believed that the first airplane carriers were built by the British Navy. They, like our first "carrier," as it was called, were converted from ships built for an entirely different purpose. The Naval Collier "Jupiter," built some years before the war as an experimental electric-propulsion ship, was selected for our first airplane carrier. The "Langley," commissioned on March 20, 1922, was named after Professor Samuel Pierpont Langley, one of the pioneers in his conceptions of the possibility of aviation.

By the terms of the Washington Treaty for the limitation of Naval Armaments, our Navy can build airplane carriers of greater than 10,000 tons displacement to a total of 135,000 tons, a part of which has already been authorized. Two battle cruisers were saved to this country by allowing them to be converted into aircraft carriers. These vessels have a displacement of 43,500 tons each. It is important that this country complete the quota of carriers allowed in order to have a well balanced fleet ready to meet any possible enemy on even terms. For without any doubt that nation which is inferior in aviation equipment will be at a serious disadvantage when entering battle.

The "Langley" is 540 feet long and looks every inch of it on account of her long flying deck. She is 65 feet wide. The flying deck extends nearly the full length of the ship and is supported on lattice-work steel towers on each side. Ground personnel is necessary for rigging the flying deck arresting gear as well as to assist the planes. In order to have them at hand when desired, and be able to clear the deck for flying, life nets are provided at the side of the flying deck. The nets are some five feet wide, made of steel in some places and rope in others. When rigged for sea they are vertical and stand about three feet above the deck.

The masts are of course kept housed when the deck is clear for flying. This is accomplished by the upper part telescoping into the lower part below the deck. The rigging and yard stows in a well, built into the flying deck, which is covered with a flush cover.

The "Langley" is equipped with the latest type of catapults for launching seaplanes from the flying deck, one near the bow and the other near the stern. These are operated by air which actuates air pistons, which move a crosshead at a high rate of speed, and this motion is multiplied by a pulley connected to a carriage which moves a track on the flying deck. The carriage is accelerated to 60 miles per hour in a comparatively short distance, and then stopped suddenly by a brake at the end of the track. This releases the plane.

Coming below the flying deck we find many unique features in the arrangements for the service of the planes. In the forward part of the ship is a thoroughly equipped machine shop for the repair or manufacture of anything required for a plane or a ship in connection with planes. An adjunct of this is an instrument room containing small precision lathes and facilities for testing or repairing most instruments used on a plane. Below the machine shop are commodious store rooms for carrying all small fittings, instruments and material used in repairs to planes, in addition to ships' equipment.

Below the well deck there are four large airplane stowage holds, approximately 40 feet by 60 feet and 30 feet deep. By disassembling the planes, it would not be difficult to stow 50 planes in each of these holds on one level. Ordinarily planes are carried with only the outer section of the wings disassembled. Each hold will in this manner accommodate ten planes.

Forward of the foremost airplane stowage hold there are two gasoline storage tanks extending from the inner (double) bottom of the ship, a few feet above the keel, to the main deck level. These tanks will hold 125,000 gallons each. They are separated from all contact with other compartments by void spaces forward, under and abaft of them. Those compartments under and abaft the gasoline tanks are kept filled with fresh water as an insulation. A slight vapor pressure of one ounce is kept on the tank at all times to prevent the escape of gas as vapor into the atmosphere. There are several gasoline stations on the main deck, including one aft for fueling seaplanes tied up to the stern of the ship. There are also three airplane fueling stations on the flying deck.

Not only does the "Langley" carry planes, but it also has all facilities for fighting with them when necessary. A torpedo room for stowing twenty-four torpedoes is located in a large hold below the main deck. This room contains also two air compressors for charging torpedoes or firing catapults, elevator mechanism, warhead locker for torpedo warheads, bomb stowage, gyro compass room and lubricating oil tanks and pumps. By means of the latter, lubricating oil may be pumped to several stations on the main deck or to the flying deck.

For handling planes from the holds and shifting them to different locations on the main deck or lifting them on to the elevator there are two cranes traveling on tracks suspended below the flying deck. Two jib cranes, one forward of the elevator on the starboard side and one aft on the port side are intended for general hoisting.

An elevator 36 feet wide by 40 feet long located centrally on the main deck is provided for hoisting planes from the well deck to the flying deck. It has a capacity of five tons at a lifting rate of 20 feet per minute and can accommodate two small planes together. The hoisting power is obtained by a 175-horsepower electric motor in a large elevator compartment below the main deck. When raised the elevator forms part of the flying deck.

Among the special features of the ship, none is of more importance than the facilities provided for weather forecasting. This is done in the aerological laboratory below the flying deck. This laboratory is equipped very completely and has two aerographers whose sole duty is weather forecasting and who have made a special study of this art. Bulletins of flying weather are issued before all flying operations. These are based on radio reports from different stations combined with local observations with the instruments furnished. It may be said that the forecasts have been surprisingly accurate.

Besides being equipped for fighting, planes are prepared for reconnaissance work by means of the photographic facilities on board. Probably the most valuable service which this laboratory and the three expert photographers gives to the ship consists in the moving pictures which they take of every landing made on deck with an ultra-rapid lens. The negative is developed, printed and shown by the machines on board. By slowing down the speed of the projector, every detail of the flight is accentuated and an analysis can easily be made of any failure.

In order to provide the last word in communication, all means of establishing contact between the ship and planes are provided. The radio equipment is unusually complete. A telephone sending set for talking to the planes and a telephone receiving set provide for voice communication with the planes. Also a pigeon house at the stern of the ship provides accommodations for 48 carrier pigeons for the care of which two specially trained pigeon keepers are assigned.

Let us imagine for a moment that we are privileged to witness a flying exhibition on the "Langley." We come on board and are escorted to the flying deck by means of a ladder near the smoke pipe, or possibly we may get a ride on the elevator. If we go by the smoke pipe we will notice smoke issuing from a funnel near the side of the ship. A spray of water will be coming out. The purpose of this is to cool the gases of combustion and thereby reduce the "bumps" in the air caused by the hot gases from the stack. We may notice that the other stack is resting horizontally facing aft in a cradle. The masts are down below the flying deck, as are the flagstaff and jackstaff; life nets are rigged out and men are standing in them; boats are in the water with necessary wrecking outfits. The ship's doctor is in one boat ready to rush to a fallen plane. Another doctor is on the flying deck. A man is standing on the bow with a large signal flag. Three planes are on deck. The executive officer is near the leading plane. The pilot of this plane signals all ready, when the men nearby release the hook which has been holding the plane to the deck. The plane speeds along the deck and into the air before it is halfway to the bow and circles over the ship, prettily as a bird. Then another plane just aft of the first one goes up, and a third one just as gracefully as the first one. The three planes

(*Continued on page 140*)

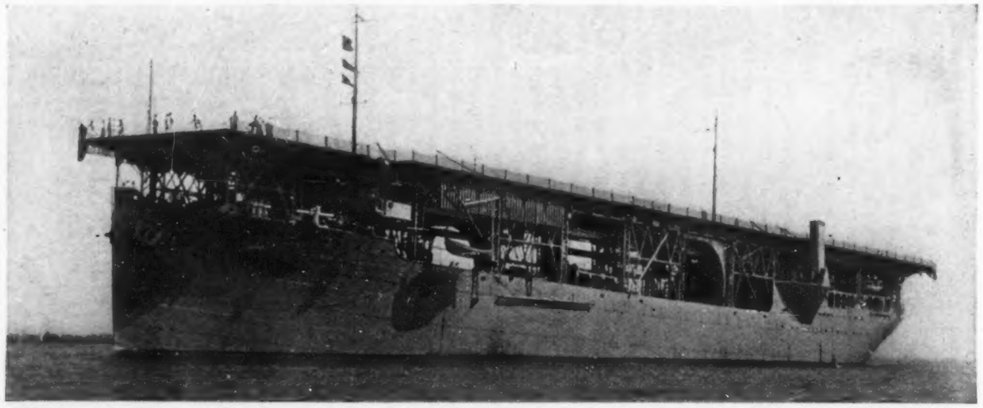
Modern Medicine and the Tropics

OUR northern winters, with their harsh climate bringing on a trail of disease, are coming to be a thing to be avoided by those who are not forced by necessity to toil in the North. There was a time, say 30 years ago, when a journey to the tropics suggested yellow fever, malaria, dysentery and other diseases too numerous to mention. Thanks to such men as Walter Reed, Major-General Wood, General Gorgas and others, these curses of the beautiful islands of the Spanish Main have been practically eliminated.

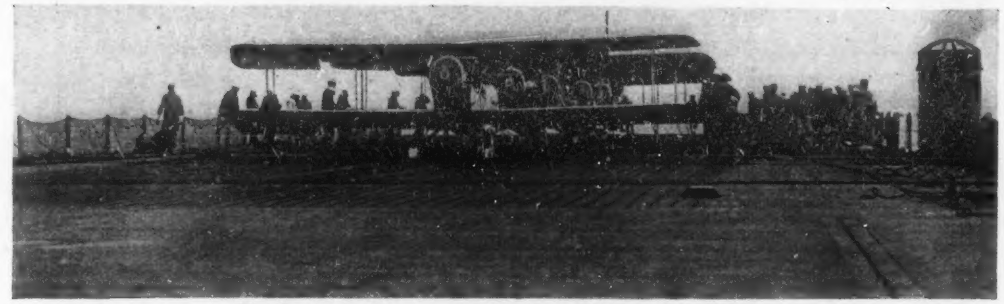
Today you can wander freely in Cuba, Porto Rico, and Jamaica with as much safety as regards health as you can anywhere in continental United States or Canada. The same is true of the tropical countries of Central and South America, provided that reasonable precautions are taken. The tropics offer great changes in temperature in and out of the sun, and it is readily possible to get a good sized chill by walking in the sun and then going into some moldy old cathedral. The tropic and the semi-tropical countries become more and more each year places in which one can live in safety and comfort, owing to the pioneer labors of specialists in medicine and sanitation who carry on an endless warfare against insect life, dirt and indifference, in order that this delightful and wholly habitable portion of the globe can be made a safe place in which a white man can live.

It is to demonstrate this safety that an expedition will be well on its way by the time this page is printed. Eighty specialists from all parts of the civilized world will meet in Kingston, Jamaica, in July for a conference on health problems as affected by the climate and environment of the tropics. Physicians, surgeons, biologists and chemists will foregather from July 22 to August 31 to discuss the combatting of tropical diseases. Such celebrated men as Dr. Banting, the discoverer of insulin, Sir James Fowler, Dr. Frederick L. Hoffman, Sir Arthur Newsholme, Sir Thomas Oliver, Dr. W. H. Park, Prof. W. H. Pickering, Sir Wm. Simpson and scores of others will be in the party.

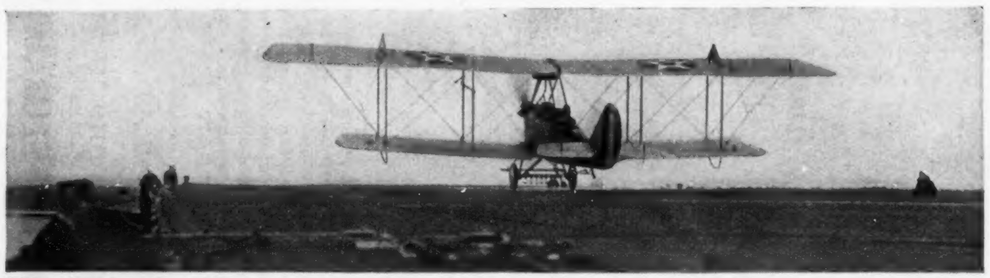
Unquestionably the greatest benefit to the world at large to be derived from the conference will be the correlation of ideas and practice on which the physicians present can reach a common understanding. Tropical diseases, in the main, are the same the world over. To be sure, Africa has the sleeping sickness, due to the Tetse fly, which is peculiar in that continent. But the diseases most dreaded in tropical countries are malaria, which undoubtedly leads all the rest, amebic dysentery, hookworm and yellow fever. These diseases have been fought by different methods. The Jamaican conference will reduce all methods to a least common denominator and there will come a common understanding of an approved method, which will be of material benefit to the medical fraternity of the world. The importance of this conference to the health of the world cannot be overestimated. The combined experiences of the doctors present are bound to have an appreciable effect on the future of the tropics as a place of residence and a place in which to do business. For doctors, like the explorers and pioneers in the early history of the United States, are the advance guard that insures the safety of those who follow. As a result of the interchange of ideas which will be provoked by the Jamaica conference there cannot but follow a marked increase in the efficiency with which they discharge this function.



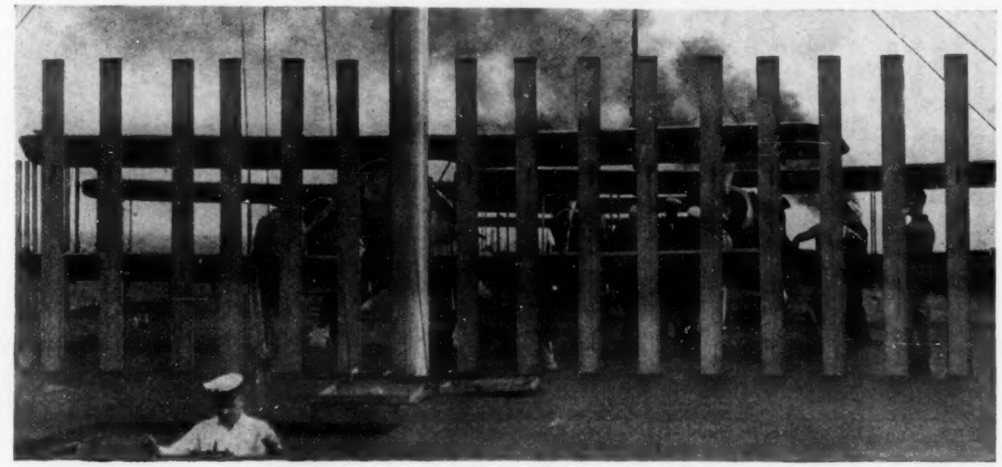
The "Langley" was built as a merchant ship during the war. In converting her to an airplane carrier a lofty, unobstructed flying deck was built above the hull and her holds converted for the storage of planes, fuel, etc. She is 540 feet long by 65 feet wide



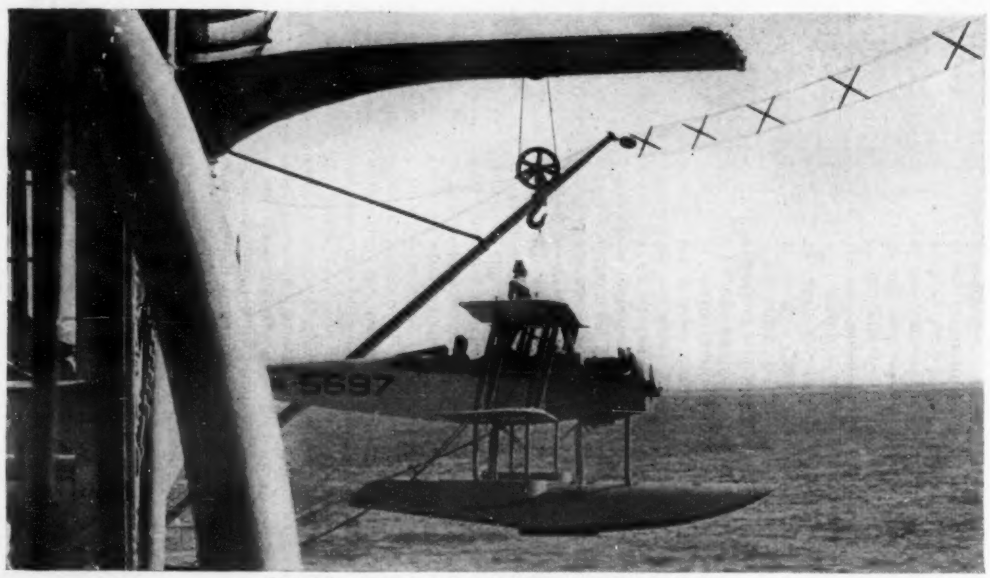
Voight land planes on flying deck, tuning up for flight



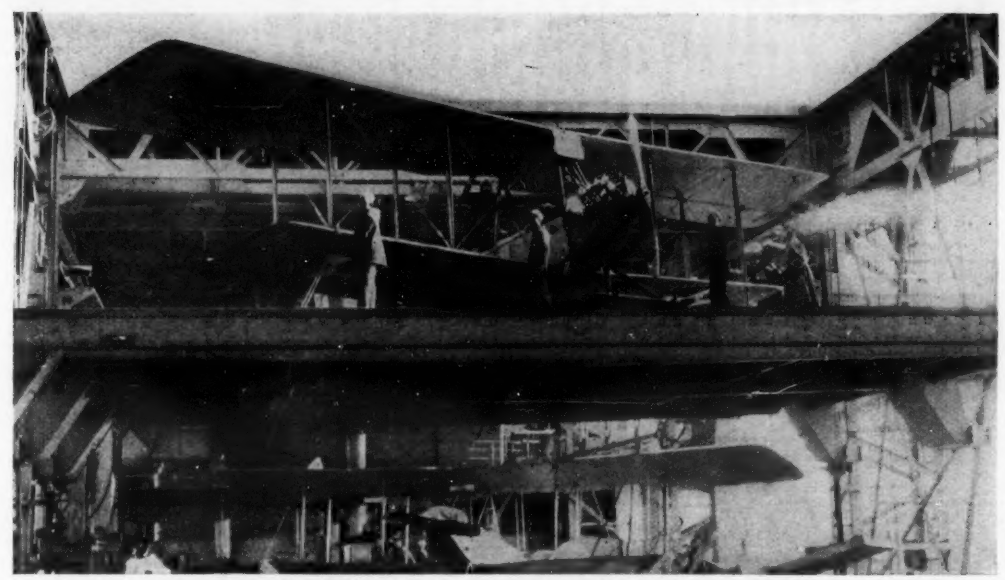
This view is taken from the netting at the side of the flying deck, looking forward. The plane is seen taking the air after a run of several hundred feet along the deck. Planes can also be launched by a catapult, not seen in the picture



Voight land planes within the shelter of the palisades



Voight seaplane being hoisted by the jib crane



Plane after flight being lowered on elevator from flying deck

A LANDING FIELD THAT GOES TO SEA: VIEWS OF OUR PIONEER AIRPLANE CARRIER "LANGLEY" AND ACTIVITIES ABOARD—(See facing page for text)

Our Abrams Investigation—XI

The Treatment End of E. R. A. and a Study of Testimonials and the Oscilloclast

By Austin C. Lescarboura

Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

EVERY generation that we know anything about has had a lot of cures for diseases; some of the cures have been guaranteed to cure a whole series of diseases, and yet after a time they have proved utterly useless. Over and over again these cures have apparently worked wonders of healing and have cured many hundreds and at times even many thousands of people, some of whom at least had been sufferers for years. Yet after a while further experience and more careful observation have shown these precious "cures" to have absolutely no efficiency in the treatment of disease. Indeed, not a few of them have proved very definitely, when the facts were all summed up, to be distinctly harmful rather than beneficial to mankind and yet there is no doubt at all that in the heyday of their popularity they accomplished results so wonderful as to tempt even the most conservative of thinkers to feel that at last here was a real panacea for human ills.

Thus writes James J. Walsh, Professor of Physiological Psychology at Cathedral College and well-known lecturer and writer on psychology, in his recent book called "Cures"—a book very much worth reading, by the way, because of the insight it gives one into the psychology of ailments and cures of the past and present—and of the future too, for all "cures" follow more or less a fixed formula.

Whether the Electronic Reactions of Abrams technique of diagnosis and treatment is valid or not, the fact remains that it has made full use of the testimonial. It was only after Upton Sinclair, the well-known writer and novelist, wrote "The House of Wonders" article, (*Pearson's Magazine*, June, 1922) that the Abrams method began to attract widespread interest. In that story Sinclair, in his characteristic style and enthusiasm, told what he had seen in the San Francisco laboratory and clinic of Dr. Albert Abrams. Sinclair should be credited with giving E. R. A. its initial popularity. His name carried a brilliant and convincing story to the masses, who quite overlooked the fact that Sinclair's name meant no more in medical research than Jack Dempsey's would mean on a thesis dealing with the fourth dimension, or Babe Ruth's on the mathematical theory of invariance.

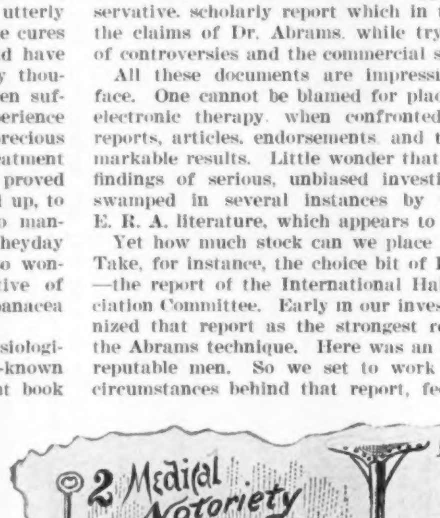
Following in the footsteps of Sinclair, numerous other scribes and editors have contributed their quota to E. R. A. literature. Alexander Marky, Editor of *Pearson's Magazine*, has been a staunch supporter of that cause, devoting much of his journal to laudatory articles, and reprinting these articles so that they might be sold by the tens of thousands of copies to E. R. A. practitioners throughout the country for distribution far and wide.

Then there is J. Aaron Lazar, Editor and Publisher of *Progress*, who is likewise an ardent champion of the E. R. A. cause. In his monthly journal appears article after article and testimonial after testimonial, not to forget the advertisements of the enterprising E. R. A. practitioners. Here again the main idea is apparently to supply the electronists, whether of the simonpure E. R. A. strain or not, with advertising literature. Copies of *Progress* are being widely circulated by electronists, who buy them in bulk for that very purpose. We have offered to set both these gentlemen straight with regard to various E. R. A. matters, but have been firmly turned down—particularly in the case of Mr. Lazar, who would not grant us space in his columns to refute misstatements regarding our investigation. Hence these gentlemen and their journals must be considered as hard-working press agents for the E. R. A. cause.

Aside from clever journalists and novelists, there are others who have contributed to the Abrams literature and whose names have given considerable weight to their writings, so far as the laity is concerned. Thus we have Sir James Barr, past President of the British Medical Association, and Sir Mather Thomson of London, England. Then there is the impressive report of the Committee appointed in 1922 by the International Hahnemannian Association to investigate the Abrams methods of diagnosis and treatment. This committee, composed of homeopaths, spent considerable time investigating the diagnostic and treatment technique, and then rendered what on its face appears to be a conservative, scholarly report which in the main endorses the claims of Dr. Abrams, while trying to keep clear of controversies and the commercial side of E. R. A.

All these documents are impressive on their very face. One cannot be blamed for placing some faith in electronic therapy when confronted with impressive reports, articles, endorsements and testimonials of remarkable results. Little wonder that the work and the findings of serious, unbiased investigators have been swamped in several instances by the avalanche of E. R. A. literature, which appears to be without end.

Yet how much stock can we place in this literature? Take, for instance, the choice bit of E. R. A. literature—the report of the International Hahnemannian Association Committee. Early in our investigation we recognized that report as the strongest recommendation of the Abrams technique. Here was an endorsement from reputable men. So we set to work investigating the circumstances behind that report, feeling that in this way we should be getting down to the bottom of the matter without wading through the dense jungle of E. R. A. activities.



THE use of the testimonial for the purpose of courting publicity constitutes one of the most despicable methods of medical advertising. There are three degrees of liar—prevaricator, liar, and, superlatively, writer of medical testimonials.

Speaking of testimonials, here is what Dr. Albert Abrams had to say. This fac-simile clipping is taken from "Transactions of the Antiseptic Club," page 66. (Published by E. B. Treat, New York, 1895)

Well, we have spent five months with the chairman of that committee and his associate. Certainly we have received sincere cooperation from this source, for both doctors have given up half a day per week for weeks on end. They have tried to convince us of the existence of the Abrams reactions and their application in diagnostic work. They have made tests for us with the Abrams method, using the rheostats and dynamizer and the drop of blood. The results of these tests have already been published in our columns. Not only did they fail to convince us of the validity of the Abrams technique, but the results brought forth the voluntary remark from the chairman of that committee to the effect that with the Abrams apparatus he has been using, he has been unable to pick out the same bloods. This means that for the same blood specimens this doctor and his associate have been unable to obtain the same findings; and that, in turn, means that the Abrams diagnostic technique, in this instance at least, is wholly unreliable and without value.

So the chairman of the International Hahnemannian Association Committee, cooperating with us in a series of Abrams blood tests, has been unable to justify the favorable report of his committee, in our estimation, at least. However, there is still another side to this work, and that is the application of the Abrams reactions to the selection of homeopathic remedies. We now have on hand the reports on fifty cases or more of drug selection through the Abrams reactions, and when these reports have been analyzed to determine their true significance, our findings will be given in these columns. However, we are frank to state at this time that we are no more impressed with the Abrams-homeopathic-drug-selection technique than we were with the blood specimen tests by the doctors already referred to.

In nine months of investigation, dealing with all kinds of electronists from the foremost workers down to the little known practitioner, we have found absolutely nothing which would provide some basis for the laudatory endorsements and reports by Sir James Barr, Sir Mather Thomson, and others. We have, however, noted a tendency on the part of conscientious doctors to seek more positive methods of diagnosis and treatment. Time and again a doctor will take up some new therapy in the hope that it may give him better results. Any sincere orthodox doctor will tell you that medicine is but an art rather than a science, and that much remains to be done. And this very fact makes it possible for a new "cure" to receive the endorsement of enthusiastic but poorly informed doctors who are swept off their feet by the brilliant appeal of something new.

So much for doctors who have endorsed E. R. A. Their endorsement today is not to be taken any more seriously than the doctors who endorsed the "cures" of yesterday—"cures" which turned out to be bald frauds or unfortunate illusions. Such endorsements do not look well alongside the poor showing of the Abrams technique under scientific tests such as have been conducted by ourselves and other disinterested parties.

Aside from the endorsement of doctors, there are the testimonials from patients. Ever since our committee began its work, we have been flooded with touching letters from all parts of the country. The fond parents write us telling how their son, who was given up for lost by the best physicians of the country, was saved at the eleventh hour by Dr. Z, an Abrams practitioner; the young girl who was dying of tuberculosis writes us how, after spending a fortune with orthodox doctors, she was speedily restored to health by the Abrams treatment; the housewife, who could no longer do her work and was a "living nothing," tells us how she was saved through the oscilloclast, and so on. Cancers, tuberculosis, syphilis, pernicious anemia vanish under the persuasive tick-tock of the oscilloclast. One Dr. Burton W. Swayze, M.D., of Allentown, Pa., an E. R. A. worker, rallied his patients and had them write to us. Copies of these letters appear in the June issue of *Progress*, as a protest against the SCIENTIFIC AMERICAN investigation which, so far, has found nothing evidential in the Abrams technique. Other electronists have done the same.

If testimonials were to be taken seriously in any scientific work, particularly medical work, then there could be no doubt of the Abrams electronic therapy. Unfortunately, testimonials of "cures" mean little or nothing. There never was a medical fake or fraud that did not boast of ample testimonials to back up its claims. Indeed, no one else but Doctor Albert Abrams himself, writing in the "Transactions of the Antiseptic Club" (E. B. Treat, New York, publisher, 1895) strongly condemned the use of the testimonial for the purpose of courting publicity in medical work. A facsimile reproduction of this statement appears herewith, and it is our answer to the E. R. A. testimonials.

We might have some measure of confidence in E. R. A. testimonials and reports of cases if they were not so uniformly rosy. But there is another side to this story. Our committee has been approached by many erstwhile electronic patients who have told us of their experiences at the hands of Abrams practitioners, and it is evident that wonderful cures are by no means universal in this line of work. The electronists will reply that they usually get the advanced cases which have been given up by orthodox practitioners, and which are too far gone even for their technique. We admit that pos-

(Continued on page 140)

Bear Mountain Hudson River Bridge

IF big dimensions make a beautiful bridge, the new bridge over the Hudson at Bear Mountain should be one of the handsomest of its type in the world. Alas, it is far from that; for, if we except the Williamsburg Bridge over the East River, New York, the Bear Mountain Bridge will rank as the ugliest, long-span suspension bridge, either here or abroad. Except for the graceful curve of the main cables (and that is determined by the natural laws of gravitation) there is not a curve in the whole structure.

This is the more reprehensible when we consider that the striking beauty of the site called loudly for the erection of a bridge that should be dignified and beautiful, if such qualities could be secured without any undue addition to the expense. And since the cost will total the very modest sum (for a bridge of this length) of under $6,000,000, the failure to pay any attention to the question of esthetic or architectural beauty is so much the less excusable.

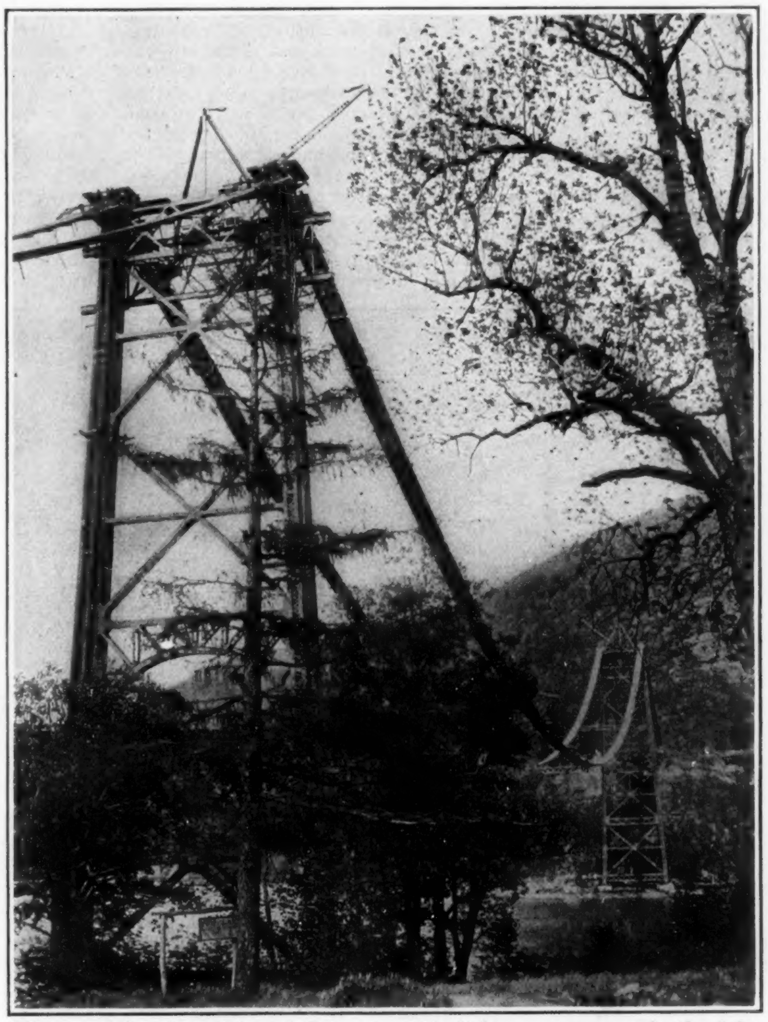
It will be evident to any engineer that the bridge is what might be called a shop job; that is to say, it was designed with a single eye to easy and cheap fabrication in the bridge mills and shops. It is all straight-line work; not a curve is to be found in any part of it. Each tower is nothing more nor less than an exaggerated gantry and, except for its size, might be duplicated on many a cableway or suction dredge. The trusses of the approaches, instead of continuing the line of the main stiffening truss, are stepped up at the first pier to save material and the few dollars resulting from this devastating economy.

The bridge spans the Hudson at a point a few miles above Peekskill, N. Y., and opposite the popular Bear Mountain resort in the Palisades Interstate Park. It is being built to form a greatly needed highway connection between the east and west banks of the Hudson, thereby giving a direct connection between the State highway systems on both sides of the river, and greatly facilitating not only the east and west roadway traffic, but that which flows in a north and south direction parallel with the river. A powerful motive for locating the bridge on the present site was the existence on the west side of the river of the Bear Mountain resort, which is visited by a large number of automobiles on every day of the year on which motor car travel is possible, and on Sundays and holidays is the mecca of those work-a-day people whose excursions far afield are limited to public holidays and the week-end.

The great length of the central span, 1632 feet, is compensated, so far as cost is concerned, by the shortness of the shore spans, and the fact that good rock is available for the tower foundations, and for the anchorages. On each side the cables will be carried down into and anchored within the solid rock of the mountain side.

The towers are 350 feet high and each will support a single wire cable 17 inches in diameter. The traffic will be accommodated on a single floor, which will provide a central roadway, 30 feet wide, and two 4-foot sidewalks. The floor will be stiffened by two trusses, 30 feet in depth.

On the western shore the bridge will connect with the Henry Hudson Highway, which, when completed, will extend from Dyckman Street ferry, opposite Manhattan, to Newburgh. On the eastern shore the bridge connects with a new highway, which is being blasted out of the mountain side and turns inland to a junction with the Albany Post Road.



This suspended roadway is being built to connect the highway systems on each side of the river and eliminate the detours and delay of the present ferries. Main span, 1632 feet; width of floor, 38 feet; height of towers, 350 feet; clear height above the river, 153 feet

Hudson River Bridge at Bear Mountain

The Utilization of Volcanic Steam in Italy

THE increased desire for economic independence that accompanied the growth of national sentiment during the war has been shown very clearly in the intensified study and exploitation of natural resources. Very little, however, has been heard as yet of attempts to utilize the interior heat of the earth, which many believe to be one of the most important potential sources of energy. Only in Italy has a definite and successful effort been made in this direction, namely, by utilizing the natural steam which emerges from the earth in volcanic districts. The jets of steam ("soffioni") and the pools of water, formed in small craters and maintained at boiling temperature by natural steam ("lagoni") have been known for centuries, but for long were regarded by the peasants as manifestations of unseen and unfriendly powers. The district which has been selected for study and exploitation forms, roughly, an elliptical area of about 2.5 square miles, lying south of Volterra and from 40 to 50 miles south-southwest of Florence. In this part of Tuscany, works for generating electrical power and for producing chemicals have been erected at Larderello and other places.

The first attempt to produce power from natural steam was made in 1897 by using it to heat water in a boiler and feeding a reciprocating engine with the pure steam. In 1905, Prince Conti fed steam direct from a "soffione" into a piston engine, and the result was so successful that in the following year a larger engine was used, and the steam generated was made to drive a dynamo for lighting the works. In 1912 it was decided to erect a 250-kilowatt turbo-generator to be worked with natural steam, but owing to fear of corrosion of the turbine blades, and the difficulty of obtaining a good vacuum in the condensers, on account of the presence of the gases mentioned above, this intention was abandoned. Intermediate boilers or evaporators were therefore constructed and used. The present large power-plant at Larderello was operated in 1916, and comprises evaporators, turbo-generators, condensers, and transformers.

According to a paper which was read by Prince Conti at the Catania meeting on April 5-11, 1923, of the Italian Association for the Advancement of Science, there is now in use a new type of evaporator in which the dissolved gases are separated from the natural steam, thus increasing the efficiency of the condensers. The pure steam, superheated with the aid of natural steam, is fed at a pressure of 1.25 atmosphere into 3000-kilowatt turbo-generators of the Parsons type, of which two are in use and one is kept in reserve. Each unit has a net efficiency of 2500 kilowatts, and generates a three-phase current at 4000 volts, 50 periods. Step-up transformers of the self-cooling oil type raise this voltage to 16,000 for distribution to the various works, and to 32,000-38,000 for transmission to Siena, Florence, and other cities.

Looking to the future, it appears more than probable that the production of power and chemicals with the aid of natural steam will not long be confined to Tuscany. Already the volcanic districts of Vesuvius, Etna, and the islands of Eolie (Lipari) are being studied. Outside Italy, like investigations are being pursued in America on the steam springs of California, Chile and Bolivia; and attention will doubtless be given to similar fields in Alaska, New Zealand and especially Japan, where such volcanic manifestations are numerous.—*Abstract from Nature, January 12, 1924.*

Wasps as Engineers

THE wasps have not advanced so far in specialization as the bees, for there are no species in which the female is devoted solely to egg production, while the colonies are annual and are founded by a solitary female. In this respect, they correspond closely with the bumble-bees, but their engineering capacity, and the size of their colonies, are far ahead of the bumble-bees. The most advanced of the social species, are the members of the genus *Vespa*.

Generally speaking the common wasp, *Vespa vulgaris* makes its nest in a hole in the ground, but it will sometimes select a hollow tree, or even build under the false roof of a house or outbuilding. In the more general case, the deserted home of some burrowing animal is selected, usually with a tunnelled entrance a foot or more long, and almost always in a bank or similar situation which is thoroughly dry and not likely to be much affected by heavy rains.

Having found a suitable chamber, the wasp first clears away any loose rubbish and, if necessary, enlarges the chamber somewhat. Commencing her work at the top, she attaches a stalk strong enough to support three cells. Both stalk and cells are constructed of the familiar paper, which, in the case of this species, is made of sound wood scraped from posts or the abraded surface of a tree trunk, and masticated with the saliva, which is extremely adhesive, dries hard, and forms an exceedingly tough compound with the fibrous material. The three cells hang downwards. Above the three cells, the insect next places a covering of the paper material. There are several layers of this, and they are not made adherent, but a small air-space is left between them. In some cases there are as many as sixteen of these paper coats, and, as a means of conserving the warmth of the nest and preventing any soakage of rain from above, it is very effective. The wasp next deposits an egg in each cell and then proceeds to construct other cells adjacent to the first, placing an egg in each as it is made. As the cells increase in number beyond the capacity of the original stalk to support, another stalk is attached to the roof, while over every additional cell the dome-like covering is extended to protect it. As soon as the first eggs hatch, the wasp desists from further cell construction for the time, and devotes her attention to the young. She collects honey from flowers and insects, preferably aphis or tender caterpillars. Neither then nor at any time is food stored in cells, for future consumption, as in the case of bees.

As well as collecting food, the wasp must also prepare a certain amount of pulp in order to lengthen the cells, for these are never raised above the height of the larva. Their original depth is about one tenth of an inch, and a daily addition is necessary to keep them at the required level. As the larvae grow, they become more hungry, and wave their heads impatiently above the cell, until their ration is given them. Each cell is treated as a separate unit in construction, the wasp not having learnt, like the bee, that a partition wall is adequate for two cells. The shape is hexagonal, however, and economy of material is scarcely less perfect than in the case of the bee. No cap is placed over the cell by the mother, but when the larva has reached maturity it spins a strong silken cocoon, which is attached to the upper edge of the cell and serves the purpose of a cap, closing the cell for the transformation into the pupal stage.—*Abstract from article by Herbert Mace, Science Progress, October, 1923.*

The Story of Steel—VII

Making the 40 Million Tons of Coke Needed Annually in Our Blast Furnaces

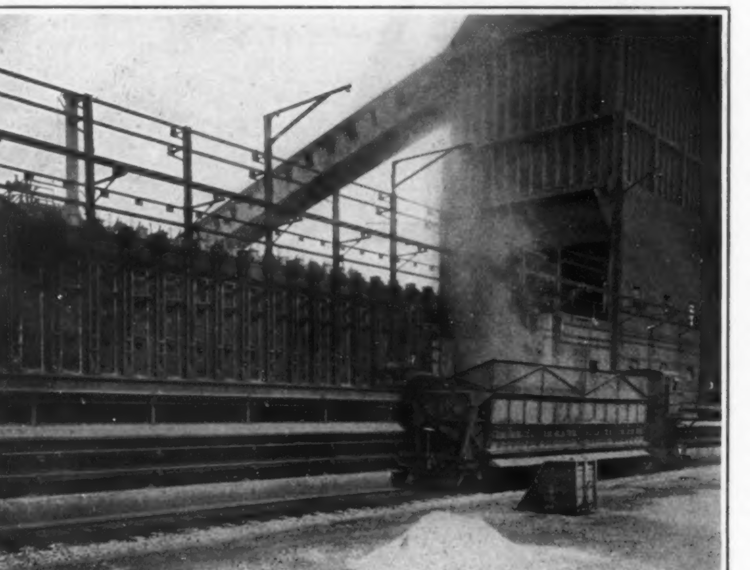
THE STORY of steel falls naturally into two divisions, the first covering the process of manufacture from the ore mine to the steel ingot, the second the fabrication of the ingot into a multitude of finished products such as rails, plates, I-beams, angles, piping, wire, nails and what not. Thus far in this series we have dealt with the iron mine, the ore steamer, the blast furnace, the converter, and the open-hearth furnace with their ultimate product the steel ingot. But before passing on to the rolling mills, a chapter must be devoted to the manufacture of coke—the fuel upon which the blast furnace depends for its mighty reactions. The large part played by coke is realized when we learn that in 1923 (the banner year in the history of steel making), no less than 40,351,000 tons of coke were consumed in the blast furnaces of the United States. Coke, as we all know, is made by the carbonization of coal, and it is the residue which is left after the volatile constituents of the coal have been driven off.

In the early days of the steel industry the coking process was carried on in what is known as the beehive coke oven—which was circular in plan and was closed with a domed roof provided with a central opening for the escape of the gases. The coal was laid on the flat floor and no attempt was made to recover the gases, which went to waste. In the manufacture of illuminating gas, where it was sought to recover the volatile elements from the coal, the coke was a matter of secondary consideration. The carbonization was and is now carried on in closed retorts, heated from the outside, the gas being purified and its by-products recovered before it is passed into large gas holders.

It was inevitable that in the steel industry the efforts of inventors should be directed to the recovery of the very valuable by-products, and gradually, during the past 75 years there have been developed various types of coke ovens, until a modern battery of ovens, such as that shown on the adjoining page, together with its elaborate by-product plant, forms one of the most admirable and efficient sections of any large steel-making plant. Not only is it now possible to produce a coke possessing the special qualities called for by the blast furnace operator, but from the gases which formerly went to waste there is now recovered a whole series of valuable by-products, and the gas itself is being used as fuel both in the coking ovens and in various furnaces throughout the steel plant. The modern coke oven, such as the Koppers installation herewith illustrated, has brought about one of the most important economies in the whole range of steel manufacture, an economy of fully 30 per cent having been secured in the manufacture of coke as compared with the older and most wasteful processes.

In the year 1906 the United States Steel Corporation sent a committee of engineers and works managers to examine the by-product coke plants of the United States and Europe, and they finally selected the Koppers Cross Regenerative Coke Oven as representing the best of the systems in operation, and recommended to their company the erection of 280 ovens of this type. The Steel Corporation informs us that the installation of the by-product ovens is today saving $8,000,000 annually in their works alone, and that it is probable that at least another $8,000,000 is being saved by the Koppers and various other by-product coke ovens among the independent steel concerns.

The Cross Regenerative By-product Coke Oven as herewith illustrated, both in our perspective view and in the longitudinal section, is a narrow rectangular chamber built of silica brick, which in its most modern dimensions will have an average width of 14 inches, height of 12 feet, and length of 40 feet. These ovens are arranged side by side in one long structure which may extend for several hundreds of feet. The ovens are separated from each other by a series of vertical flues in which burning fuel gas provides the heat necessary for coking the coal in these retorts. Directly beneath each retort is an individual regenerator, similar in its principles of construction and operation to the hot stoves which we illustrated in our articles on the blast furnace and the open-hearth furnace. In these regenerators the air for combustion is pre-heated. The two ends of each oven are closed with tall narrow doors, sealed with clay. The heating gas passes from the gas holder through the fuel gas main and into the risers opposite each oven, and the air for combustion is heated to a high temperature by being drawn through the brick checker-work of the regenerator below. The heated air meets the incoming gas stream at the base of the vertical flue, when the burning gases pass upward in the flue. From the top of the vertical flues the hot gases of combustion pass through suitable flues over the top of the vertical flues and down into the opposite regenerator. Here they give up a large part of their heat to the brick checker-work. After this has continued for about 20 minutes, the flow of air and gases is reversed, the fresh air passing up through the heated checker-work, recovering and returning to the oven flues all the heat except that which (about 500 degrees Fahrenheit) is required to produce the necessary stack draft. It is impossible, within the limits of this article, to go into more detail in explaining this operation, and it must suffice to say that the flow of the gases is automatically reversed at regular intervals, and that the flow is so adjusted that the charge of coal is heated evenly throughout the whole height and length of the oven, and a coke produced which is firm; that is to say, which will not shatter, and which has sufficient crushing strength to bear in the blast furnace the enormous load of 1300 tons of the burden over head. A uniform transfer of heat to the charge of coal in the oven has been secured by narrowing the width of the ovens which formerly were about 20 inches wide as against a present width of 14 inches.



Discharging side of the coke ovens at the Gary steel plant, showing the quenching car into which the coke is loaded. In the rear is one of the coal bunkers

Our full-page illustration gives an excellent idea of the general layout of an up-to-date plant. Coal brought in on railroad cars is discharged into hoppers *A*, as shown in the right-hand foreground of the illustration. From the hoppers it is fed on to an inclined belt, which in turn discharges it on to a long 36-inch belt on which it is conveyed to the top of the breaker building *B*, where coal is broken up to pass through a 1½-inch screen, and here at the same time the refuse, such as slate, bits of iron, etc., is removed. From the bottom of the breakers a 30-inch belt on an incline of 20 degrees, carries the screened coal to a transfer tower, and thence it passes over another 30-inch belt, to the head house above the large coal bunker *C*, which has a capacity of 1000 tons and serves a complete battery of ovens. Below the bunkers and traveling on the roof of the ovens is a larry, containing four cone-shaped hoppers *D*. The bottoms of these hoppers register with a series of four holes in the top of each retort, through which the exact amount of coal to fill the retort is discharged.

During the process of coking the gases pass through the roof of the retort and enter a 60-inch collecting main *L*, which extends the full length of the bank of ovens, the temperature of the gas being approximately 1000 degrees Fahrenheit. In the collecting main the gas is sprayed with tar and ammonia liquor, the sprays being located at every four feet along the main; and here it is cooled to 210 degrees Fahrenheit. The heavy tars are condensed out of the gas in the collecting main and washed along by the flushing liquors to the suction main, from which it is collected through traps. The gas is led through pipes *N* to the coolers, and ultimately to the by-product plant which is housed in its own separate building.

When the coking of an oven is completed, the end doors are removed and the coal is discharged by means of a large, powerful, electrically operated machine known as the "pusher," which is mounted on tracks running parallel with the ovens. The pushing is done by a horizontal bar *G*, carrying at its further end a vertical plate, whose area is slightly less than that of the cross section of the retort. As the red-hot mass of coke emerges, it falls into a quenching car *H*, which is of sufficient size to contain a full charge. A little electric engine now runs the car into the quenching house *J*, where sprays of water fall upon the coke, and cool it off. The coke is then discharged through the side of the car to an inclined coke wharf *K*, from which it falls on to a coke conveyor belt and ultimately finds its way to the charging hoppers of the blast furnaces.

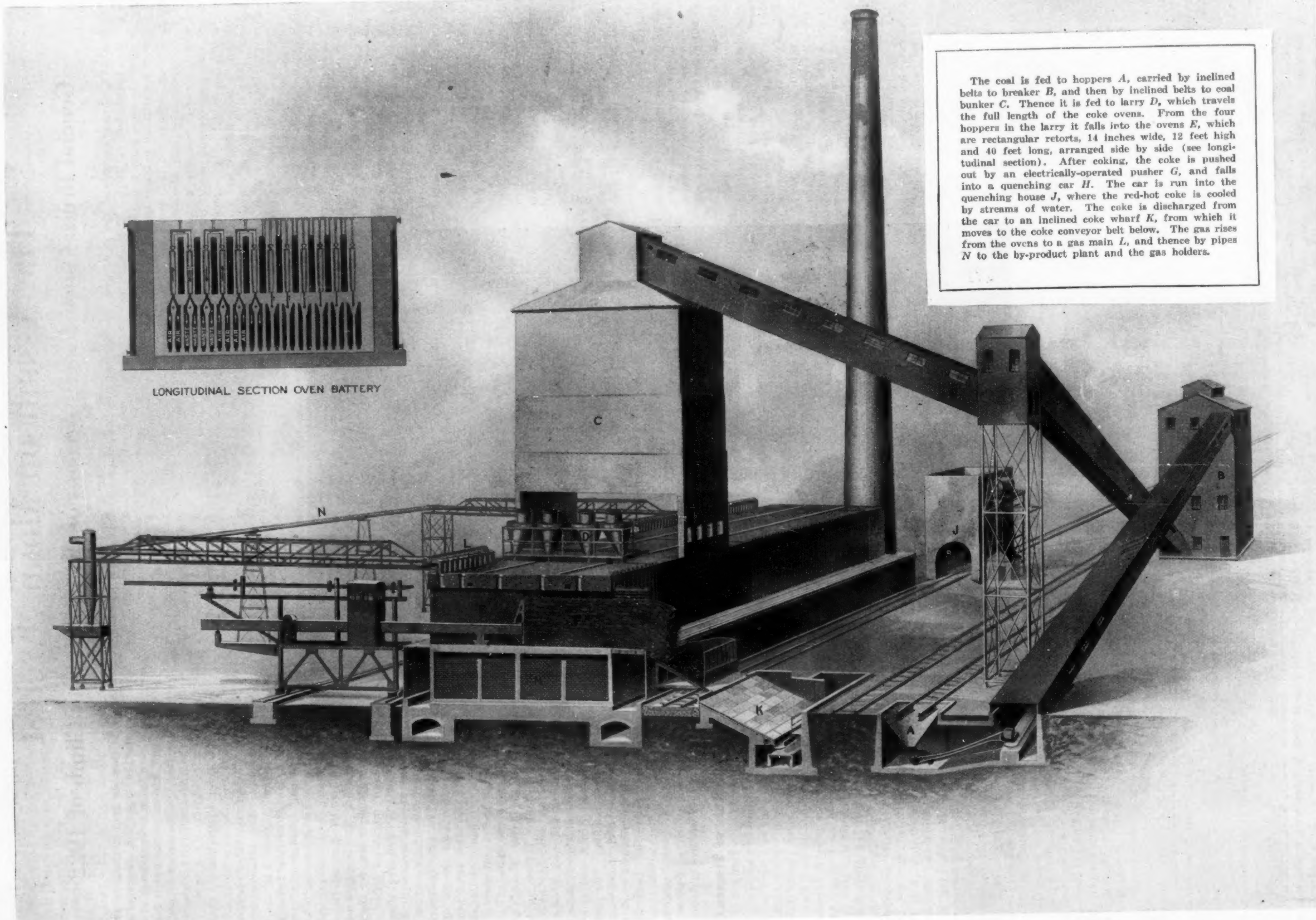
In addition to the tar and ammonia liquor recovered in the collecting main and washers, a number of the highly valuable by-products, including benzol, are recovered after the gas enters the by-product house, an adequate description of whose plant and processes would call for a separate chapter.

As showing the great saving achieved by the substitution of the by-product for the beehive oven, consider the following facts. In the beehive type about 60 per cent by weight of the coal is recovered as coke; by the by-product type about 75 per cent. The 12 blast furnaces at Gary consume some 6000 tons of coke per day, and to produce this about 8000 tons of coal are needed in the ovens. If beehive ovens were substituted for the by-product ovens at Gary, it can be realized that the coal consumed daily would be enormously increased. The annual saving, indeed, has exceeded 2,000,000 tons of coal. And to this must be added the saving in the by-products recovered from the volatile constituents of the coal, which are entirely lost in the beehive ovens, being discharged into the air. The by-product plant at Gary forms one of the most interesting developments in this great establishment. There is no branch of this or any other modern steel plant that expresses more emphatically the highly developed technique of the United States steel industry.

We close with the following analysis of results obtained in one of the latest types of Koppers ovens:

Gross coking time	11 hrs. 46 min.
Net coking time	11 hrs. 26 min.
Coal per oven per day	28.7 tons
Total coke yield—per ton of coal	75.75 per cent
Furnace coke yield—per ton of coal	63.07 per cent
Domestic coke yield—per ton of coal	6.98 per cent
Breeze—per ton of coal	5.70 per cent
Total gas yield—per ton of coal	11,360 cu. ft.
Tar yield—per ton of coal	12.37 gallons
Sulphate yield—per ton of coal	25.21 pounds
Light oil yield—per ton of coal	4.03 gallons

In addition to the advances which have been made in coke oven design in the United States, we are informed by Joseph Becker, a leading authority on by-product coke ovens, that "the organizations operating the coke ovens consist generally of technically trained men with good practical experience; the latter not being generally the case in Europe." As a result of these factors, coupled with the use of silica brick for the furnaces, the same authority tells us, that, as compared with Europe, "America can make the same quantity of coke from the same coals in one-half the number of ovens."



The coal is fed to hoppers *A*, carried by inclined belts to breaker *B*, and then by inclined belts to coal bunker *C*. Thence it is fed to larry *D*, which travels the full length of the coke ovens. From the four hoppers in the larry it falls into the ovens *E*, which are rectangular retorts, 14 inches wide, 12 feet high and 40 feet long, arranged side by side (see longitudinal section). After coking, the coke is pushed out by an electrically-operated pusher *G*, and falls into a quenching car *H*. The car is run into the quenching house *J*, where the red-hot coke is cooled by streams of water. The coke is discharged from the car to an inclined coke wharf *K*, from which it moves to the coke conveyor belt below. The gas rises from the ovens to a gas main *L*, and thence by pipes *N* to the by-product plant and the gas holders.

The general layout of a Koppers Becker by-product coke oven. The gas distilled from the coal is led to a separate plant for the recovery of its valuable by-products. It should be noted that the stack temperature is reduced to 500 degrees (See facing page for text)

The Assault on Mount Everest

General Bruce Concludes His Account of the 27,000-Foot Climb of 1922

WE HAVE already chronicled the results of the Expedition of 1921. This was a reconnaissance pure and simple. They were not sent out to climb Mount Everest, but to reconnoitre the mountain from every direction and discover which was the easiest way up. For it was quite certain that only by the easiest way possible—and only if there were an easy way—would the summit ever be reached. In the Alps men look for the most difficult way up a mountain, but with Mount Everest it is very different. The exhaustion produced from the difficulty of breathing in enough oxygen at the great heights is so fearful that only by a way that entails the least possible exertion can the summit be reached. Hence the necessity for spending the first season in thoroughly prospecting the mountain. This was all the more necessary because no European so far had been within 60 miles of Mount Everest.

During 1921 this reconnaissance was most thoroughly carried out and ample data was brought back on which to make plans for the 1922 assault. The world knows, of course, that the attempt ended in failure but it was a glorious failure and Brigadier-General Hon. C. G. Bruce, C.B., M.V.O., in a work entitled "The Assault on Mount Everest 1922" explains why. This sumptuous book published by Longmans, Green & Co., goes on the shelf as the previous volume and we read on the backs "Reconnaissance," "Assault," and we hope there will be a third volume called the "Conquest" before another 12 months are passed. This will make a great trilogy of man's conquest of nature's last and most precious treasure. Effort and human life must be sacrificed before the end can be attained, and it must be, for an Englishman and especially an English mountain climber does not know the word failure—success postponed perhaps, but in the end even Mount Everest must succumb.

To those who are not specially interested in geography and mountain climbing, the question naturally presents itself as to "what is the use." Sir Francis Younghusband in his introduction answers the question in general terms as follows:

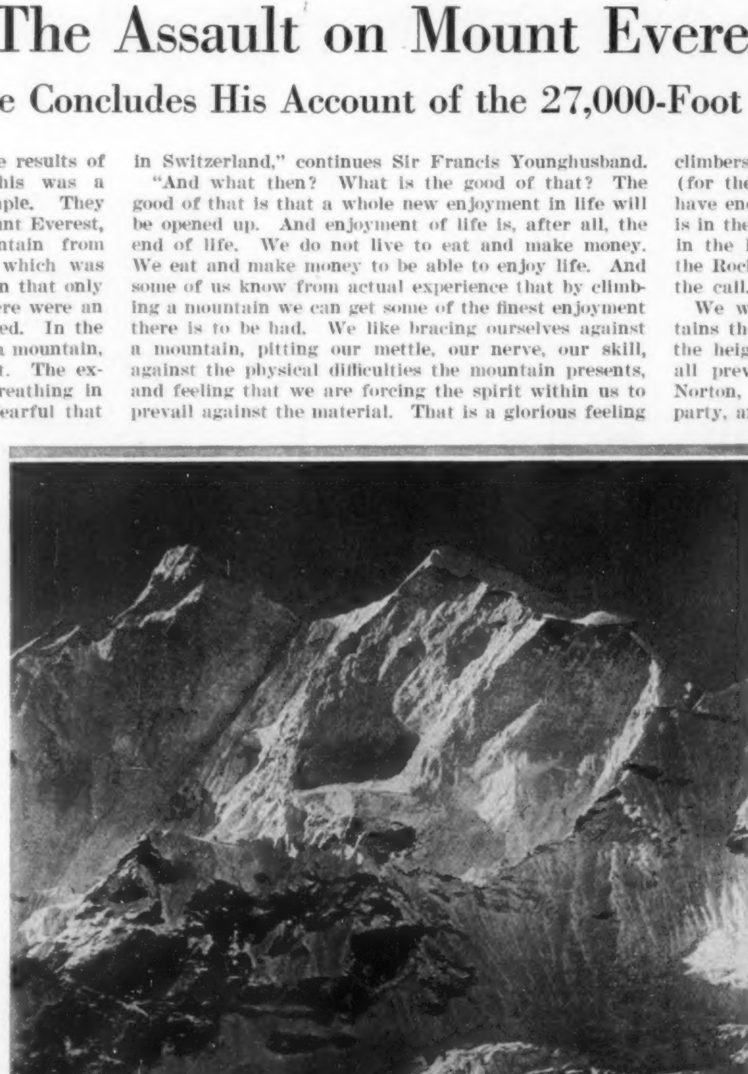
"These repeated efforts to reach the summit of the world's highest mountain have already cost human life. They have also cost much physical pain, fatigue, and discomfort to the climbers. They have been very expensive. And there is not the slightest sign of any material gain whatever being obtained—not an ounce of gold, or iron, or coal, or a single precious stone, or any land upon which food or material could be grown. What, then, is the good of it all? Who will benefit in the least even if the climbers do eventually get to the top? These are questions which are still being continually asked me, so I had better still go on trying to make as plain as I can what is the good of climbing Mount Everest.

"The most obvious good is an increased knowledge of our own capacities. By trying with all our might and with all our mind to climb the highest point on the earth, we are getting to know better what we really can do. No one can say for certain yet whether we can or cannot reach the summit. We cannot know till we try. But if—as seems much more probable now than it did ten years ago—we can reach the summit, we shall know that we are capable of more than we had supposed. And this knowledge of our capacities will be very valuable. In my own lifetime I have seen men's knowledge of their capacity for climbing mountains greatly increased. Men's standard of climbing has been raised. They now know that they can do what 40 years ago they did not deem in the least possible. And if they reach the summit of Mount Everest, the standard of achievement will be still further raised; and men who had, so far, never thought of attempting the lesser peaks of the Himalaya, will be climbing them as freely as they now climb peaks in Switzerland," continues Sir Francis Younghusband.

"And what then? What is the good of that? The good of that is that a whole new enjoyment in life will be opened up. And enjoyment of life is, after all, the end of life. We do not live to eat and make money. We eat and make money to be able to enjoy life. And some of us know from actual experience that by climbing a mountain we can get some of the finest enjoyment there is to be had. We like bracing ourselves against a mountain, pitting our mettle, our nerve, our skill, against the physical difficulties the mountain presents, and feeling that we are forcing the spirit within us to prevail against the material. That is a glorious feeling in itself and a real tonic to the spirit—even when it does not always conquer.

"But that is not all. The wrestling with the mountains makes us love the mountain. For the moment we may be utterly exhausted and only too thankful to be able to hurry back to more congenial regions. Yet, all the same, we shall eventually get to love the mountain for the very fact that she has forced the utmost out of us, lifted us just for one precious moment high above our ordinary life, and shown us beauty of an austerity, power, and purity we should have never known if we had not faced the mountain squarely and battled strongly with her.

"This, then, is the good to be obtained from climbing Mount Everest. Most men will have to take on trust that there is this good. But most of the best things in life we have to take on trust at first till we have proved them for ourselves. So I would beg readers of this book first trustfully to accept it from the Everest climbers that there is good in climbing great mountains (for the risks they have run and the hardships they have endured are ample enough proof of the faith that is in them), and then to go and test it for themselves—in the Himalayas, if possible, or if not, in the Alps, the Rockies, the Andes, wherever high mountains make the call."



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The closest photograph yet made of the world's highest mountain

We will now refer to the book. This volume contains the narrative of the stupendous climbs in which the height of 27,000 feet was reached, thus eclipsing all previous records. The achievements of Mallory, Norton, Somervell and Morshead in the first climbing party, and of Finch and Geoffrey Bruce in the second, were only possible for men of splendid physique and enormous powers of endurance, and demanded very perfect organization on the part of the leader of the expedition. The use of oxygen apparatus was seriously tested for the first time and produced results of great scientific importance. A third great climb later in the season was unfortunately interrupted by the terrible avalanche which overwhelmed the party soon after the start, resulting in the sad death of several of the Tibetan porters. All the arrangements for the successful conduct of the expedition, the supply of mules and porters, the negotiations with the Tibetan authorities en route, the great Base Camp and the smaller camps higher up the mountain involved an enormous amount of work, and the utmost tact in surmounting difficulties and obstacles; these are described by General Bruce, and provide most entertaining reading. The photographs are, if possible, even more wonderful than those in the previous work and the map of the country has been thoroughly revised in the light of the latest experience.

We shall be greatly interested in chronicling the third expedition's results as soon as they are available for publication.

The Culture of Tissues Outside the Body

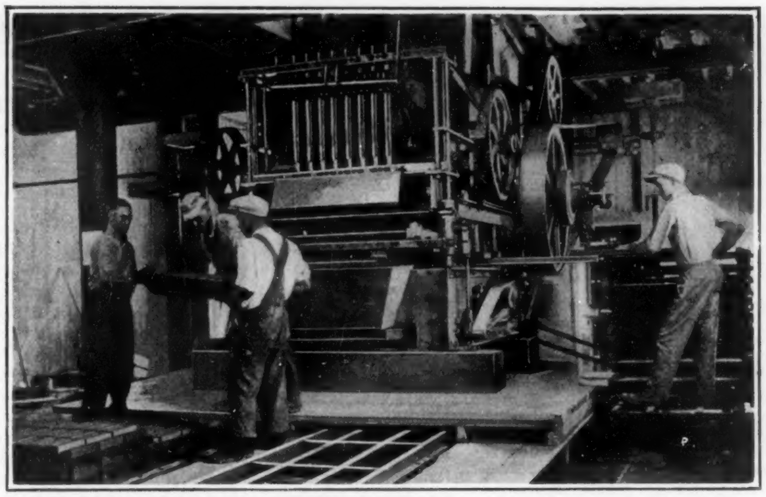
THE culture of tissues outside the body is throwing new light on the conditions requisite for the multiplication and differentiation of cells. R. G. Harrison (1907) was the first to devise a successful method by which the growth of somatic cells in culture could be followed under the microscope, and he was able to demonstrate the outgrowth of nerve-fibers from the central nervous tissue of the frog. Burrows (1911), after modifying the technique, cultivated nervous tissue, heart-cells, and mesenchymatous tissue of the chick in blood-plasma and embryonic extract, and this method has become a well-established means of investigation of cell-growth, tissues from the dog, cat, rat, guinea-pig and man having been successfully grown. One strain of connective tissue-cells (fibroblasts) from the chick has been maintained in culture in vigorous condition for more than ten years, that is, for probably some years longer than would have been the normal length of life of the cells in the fowl. Heart-cells may be grown generation after generation—all traces of the original fragment of tissue having disappeared—the cells forming a thin, rapidly growing, pulsating sheet. Drew (1922) has recently used, instead of coagulated plasma, a fluid medium containing calcium salts in a colloidal condition, and has obtained successful growth of various tissues from the mouse. He finds that epithelial cells when growing alone remain undifferentiated, but on the addition of connective tissue differentiation soon sets in. Study of the conditions which determine the growth and differentiation of cells is only at the beginning, but it is evident that a new line of investigation of great promise has been opened up, which should lead also to a knowledge of the factors which determine slowing down of the division-rate and the cessation of division, and finally the complete decline of the cell.—*Abstract from address by Professor J. H. Ashworth, British Association.*

A Super-Industrious Brick-Making Machine

A NEW automatic brick machine, shown in the accompanying view, will turn out 100 concrete bricks per minute. The entire operation is very simple and is carried on automatically. A man feeds the concrete mix to the mixer of the machine, the mix being discharged directly into the hopper. The latter, by means of an endless-chain conveyor, carries the mix up into the charger, which keeps moving over the molds and distributes the concrete among the molds in such a way that each receives the full amount of material for a brick.

The charger then withdraws and the tamper comes down and exerts the required pressure on the brick. The mold strips upward, the tamper moving up with it, and the finished brick is left on the "pallet." The loaded pallet is pushed out and the bricks carried off; the man at the machine at the same time pushes an empty pallet in place, and the operation is repeated. A guide bar at the front of the machine keeps the pallets in proper place. As the machine operates twelve and a half times a minute, and eight bricks are made each time, the total is 100 bricks per minute.

The various parts of the machine are so accurately inter-timed that it operates with the precision of a watch. Each tamper head has a face the size of a brick and weighs more than 250 pounds; the tamper drops with an impact exceeding 2200 pounds. The bricks are flat, 2¼ inches high, and may be made with or without the "frog."



Every minute of its operation this ingenious machine turns out 100 concrete bricks. The only labor required is that of feeding the concrete mix to the machine and removing the pressed bricks

Making Castings Without Sand

A LONG-SOUGHT goal in the average foundry has been some means of eliminating the sand used in making molds. This is true whether it be an iron foundry, a steel foundry or a brass foundry. Foundrymen in general have always realized that the destruction of the mold every time a casting is poured is an inefficient method of manufacturing. Attempts in the past, however, to make a mold which would last several or many times, out of something besides sand, have been generally unsuccessful and the attempts date back many, many years. Molds made of stone were probably the first of this kind but they have not been adaptable to modern practice. Of course, the iron mold has been used for some years under the name of "permanent mold," and it is today the basis of processes involving the centrifugal casting of metals; but in simpler forms it has never been successfully adapted to the foundry industry, principally because the molten metal, when poured into an iron or steel mold, is under influences entirely different from those existing in the ordinary sand mold.

Recently success has been attained in the development of what is termed "a long-life mold" by the use of which hundreds of castings can be made without the employment of any sand at all. At a plant in Detroit where carbureters for automobiles are the regular product, a most interesting apparatus has been developed by means of which molds of long life have already had as many as 10,000 castings made in them with the result that not one of the molds has had to be discarded. The system advised by the company referred to has been carefully worked out in every detail and is fully patented. According to a description by an authority in a foundry industry, the several steps and the reasons for operating the process are about as follows:

The primary idea has been to make a very light cast iron mold, the surface of which is covered with a layer of highly refractory material, of necessary thickness, and this refractory material so protected from abrasion and penetration of fine iron filaments, that it almost wears to a polished surface and only on rare occasion needs to be patched up or re-faced. For operating purposes, where the castings are not large, a group of molds is placed upon a revolving table and the several steps of the cycle can be carried out almost completely automatically.

The refractory material forming the mold surface consists of two items, the refractory material itself, and the binder to bind it to the iron backing. The refractory material can be any of the usual substances used to resist heat in the arts. The material is preferably put on in comparatively thin layers, and each one baked on before the next is applied. For the heavier facings, the final layers can be applied by transfer from what would be a metal pattern, so that the accuracy of the finished long-life mold leaves nothing to be desired.

The final heating—in effect a skin-drying at temperatures to almost vitrify—being accomplished, the molds are placed in their proper position on the revolving table, and successively follow their prescribed course. In passing around, the two parts of the mold are drawn apart sufficiently to allow the setting of cores but, just before this, each mold successively passes a flame of acetylene gas which smokes the inner surfaces heavily. The idea of this is to interpose a film of carbon between the refractory surface and the molten metal, of sufficient strength to effectively prevent actual contact of metal and refractory material at the instant of greatest temperature effect.

After passing the flame and the position where cores can be set, the two parts of the mold are made to close automatically and are held thus until poured off and the metal has sufficiently set. Then they quickly open and the castings are forced out by pins or in other suitable ways.

Next, a blast of air at high pressure rapidly blows the surfaces clean and the mold passes before the acetylene flame again. The men setting the cores, or in their absence, any attendant watches out for the mold surface condition as the molds pass open, and any fragment of iron or core left in the mold is easily removed with a suitable tool.

The iron backing of the mold has been stated as comparatively thin. This allows —particularly if constructed with that in view—the use of air-cooling action. Where such an air blast for cooling the iron molds a little faster than they would normally cool is in use, the machine can be speeded up and thus give a larger production.

Whether pouring is done by hand or from suspended ladles; whether the man remains stationary while pouring as the mold passes him or a moving platform accompanies the table; whether the molds and cupola are together or iron has to be carried from a distance; and lastly, whether molds are poured all day long or merely the usual two or three hours depends upon the individual situation.

It may be of interest to state that with 12 single molds on the revolving table, one man can pour 400 castings of a given kind per hour. With sand casting it takes eight times the number of man-hours to get an equal number of the same kind of castings.

While the process is still in its infancy and attention has naturally been given to quantity production of the comparatively light castings required, nevertheless many automobile pistons have been made also, and these involve somewhat thicker sections. It will become a matter of heavier refractory coatings, and more frequent repair of exposed points in these coatings, when larger work is undertaken.

A Subway for Sydney

QUITE the largest work at present in course of construction in the commonwealth is the underground railway to serve the city of Sydney, the capital of New South Wales. Sydney, with its immediate suburbs, has a population of more than a million. To improve the traffic facilities the existing suburban railways are now being electrified and extended into and around the city, forming a city loop from which railways will lead to the western and eastern suburbs, at present served by a street railway service system. The total estimated cost of this work is approximately $50,000,000. Jointly with the construction of the city railway is the construction of a bridge spanning Sydney harbor in one clear span of 1600 feet, and accommodating railway, vehicular and pedestrian traffic.

Left: Battery of three permanent mold machines in operation. The molds are mounted on a turntable to facilitate the various operations. *Right:* View of molds with sand core in position in center mold. These particular molds are used in casting carbureter parts

Molding without sand: Using permanent molds of cast iron for the speeding up of foundry work

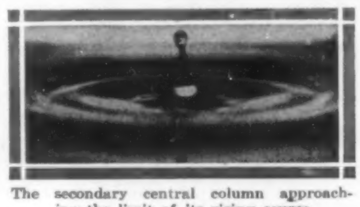
Volcanoes or Cosmic Shell-Holes?—II

A Critical Comparison of the Moon Craters with Experimental Splashes

By Daniel Moreau Barringer

(Concluded from our July issue)

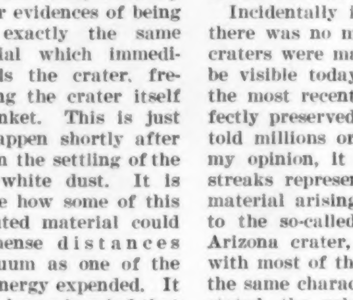
ON THE theory of impact how easy it is to realize that the bodies or masses of matter which were being gathered in by the moon might fall *anywhere* on its surface, as they seem to have done, on the great "plains" or "seas," on the "mountains," and in a great number of instances making smaller craters of the same type in pre-existing craters. It is of interest to note that they frequently cut into the rim of a pre-existing crater, as one might do with a circular die or punch on a miniature model, an effect which I believe is not explainable on any theory of volcanism which can possibly be offered.



The secondary central column approaching the limit of its rising course

When water splashes into water

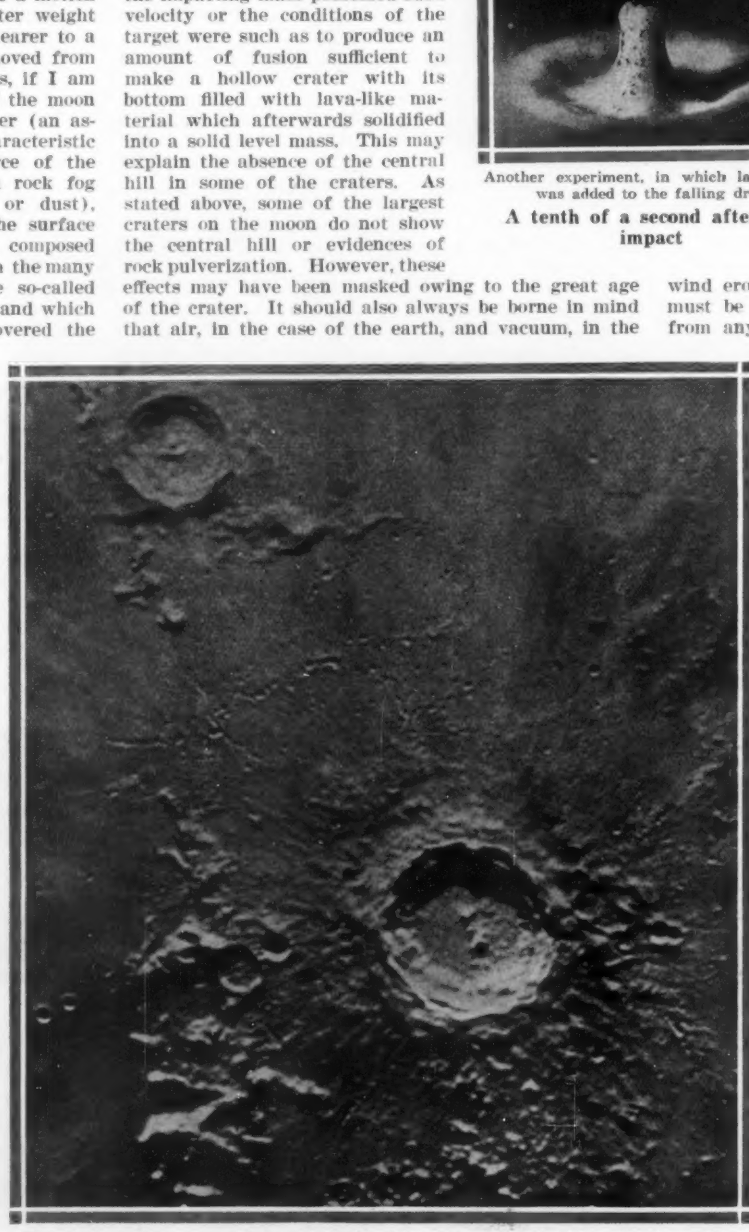
As already stated, it is not difficult to pick out the most recent of the lunar craters. These impacts occurred, as I think, when the surface was solidified, possibly into what we term acid igneous rocks, it being assumed that being lighter in weight and also in color they would tend to float up to the surface of a molten mass, while the basic igneous rock of greater weight and darker in color would be beneath and nearer to a metallic core, if it exists, much further removed from the lunar surface. These acid igneous rocks, if I am right in the assumption that the surface of the moon is largely composed of rocks of this character (an assumption which I make to account for a characteristic phenomenon), when pulverized by the force of the impact into microscopic particles making a rock fog (excessively finely divided rock particles or dust), would have the effect upon settling upon the surface of the moon of producing a whitish area composed superficially of rock flour, not dissimilar from the many millions of tons of the almost snow-white so-called "silica," which surrounds the Arizona crater and which certainly for months after that impact covered the crater itself and the plain round about for a mile or more. This is an effect which is very similar in appearance to that which we observe in the case of a number of lunar craters and the area immediately surrounding them. This exceedingly fine and white rock flour or dust would, of course, brilliantly reflect sunlight, an effect which can be best seen through a telescope when the moon is at full. Certain photographs, however, show the effect very well. Tycho, Copernicus, Kepler and Aristarchus are good examples. There are the same streaks or spurts of ejected fragmentary material, including, of course, the rock flour or dust, which radiate from the crater, an effect which could not be produced by volcanic action but which we now know can be produced by the tremendously violent impact of an extra-terrestrial mass striking the rocky crust of this earth. The effect would be that of an explosion and the finely comminuted rock, some of it reduced to the finest conceivable state of subdivision, would be shot out in great jets in all directions or radiantly from the point of impact. In the vacuum surrounding the moon this fine dust would, of course, fall vertically on the surface with the effect of producing these radiant streaks of white material. It is conceivable, of course, that the explosion actually carried solid matter over into the gaseous state, and was immediately followed by solidification. In this case the material as it was being propelled in straight lines from the crater might be referred to as rock vapor or rock fog, but the effect upon solidification and settling would be the same. A notable characteristic of these radiant streaks, extending for a number of hundred miles from Tycho and also to a less remarkable extent from Copernicus, is that they cast no sunset shadows, as do all the projections from or protuberances on the moon's surface, such as the crater rims and the lunar mountains. These streaks or spurts of material, certainly ejected from the crater, seem to bear evidences of being composed of exactly the same whitish material which immediately surrounds the crater, frequently covering the crater itself as with a blanket. This is just what would happen shortly after the impact upon the settling of the cloud of fine white dust. It is easy to imagine how some of this finely comminuted material could be driven immense distances through a vacuum as one of the results of the energy expended. It must always be borne in mind that the impact was terrific and, there being no atmosphere, that the checking up was very sudden just at the moment of impact, which would mean pulverization, crushing to fragments, and in some cases fusion. Under certain conditions it may have been that the impacting mass possessed such velocity or the conditions of the target were such as to produce an amount of fusion sufficient to make a hollow crater with its bottom filled with lava-like material which afterwards solidified into a solid level mass. This may explain the absence of the central hill in some of the craters. As stated above, some of the largest craters on the moon do not show the central hill or evidences of rock pulverization. However, these effects may have been masked owing to the great age of the crater. It should also always be borne in mind that air, in the case of the earth, and vacuum, in the case of the moon, have their peculiar effects on impacts of the kind which we are considering.



Another experiment, in which lamp-black was added to the falling drop

A tenth of a second after the impact

Incidentally it is of interest to note that certainly there was no meteoric water on the moon when these craters were made. If it was present there would not be visible today these practically unaltered effects of the most recent impacts, effects which have been perfectly preserved on a rainless or dry moon during untold millions or even billions of years. Therefore, in my opinion, it is highly probable that these radiant streaks represent spurts of finely comminuted ejected material arising on high velocity impact, very similar to the so-called silica (pulverized sandstone) of the Arizona crater, which is of minute size as compared with most of the visible lunar craters but which shows the same characteristic evidences of terrific impact. As stated, the velocities of the impacting masses which made the lunar craters must have been far in excess of those on earth, as there was no checking by an atmosphere. As I pointed out years ago in my papers on the Meteor Crater of Arizona, such vast quantities of minutely pulverized sand grains could not be produced by a steam explosion or by any volcanic agency, as we understand volcanism. It must always be borne in mind that the pull of gravity on the moon is only one-sixth of that of the earth and that there has not been the resistance of an atmosphere to retard the forward movement of the excessively finely divided material thrown out of the craters in radiant streaks by the force of the impacts. Moreover, it is evident that there has been no water or wind erosion since the craters were made. This fact must be borne in mind when considering the subject from any angle. Evidences of erosion, as we understand it, are not observable on the moon's surface. The reason seems to be a simple one. Erosion, as we know it, could not begin to be operative until the orb acquired sufficient gravitative force to hold the gases which form an atmosphere similar to that of the earth, and the first rains began to fall. No rainfall, no erosion, and, presumably, no volcanism.



Two large craters on the moon, showing the characteristic pimples which Mr. Barringer regards as analogous to the central column formed in ordinary liquid splashes

I find that some astronomers still cling to the belief, despite the opinion of Jeans and other physicists, that there was a time when there was water on the moon's surface. As far as we are able to judge there is not the slightest evidence of water erosion during the period when the *oldest* craters were formed. We know that a great many craters have been made since that time and yet these very oldest craters have exactly the same physical aspects as the more recent craters, making the inference unavoidable that the surface conditions of the moon were much the same at the time they were made as when the younger craters were made. It seems very clear, therefore, that we must search for some other origin of these remarkable craters than the commonly accepted one of volcanic activity. There is apparently no other theory which is supported by the facts except that the craters and the "seas" are due to the impacts of great masses of extralunar material. On this theory these features of the lunar surface have been beautifully preserved for our study for perhaps much more than a billion years. In my opinion all evidences of similar impacts on the then surface of the earth were obliterated in those extremely remote geological times when the forces of erosion first became active.

One who is not familiar with the behavior of projectiles and the sort of craters which they make, whether that projectile be a load of shot (a cluster of

(Continued on page 142)

Dummy Airplanes as an Aid to Aeronautical Designing

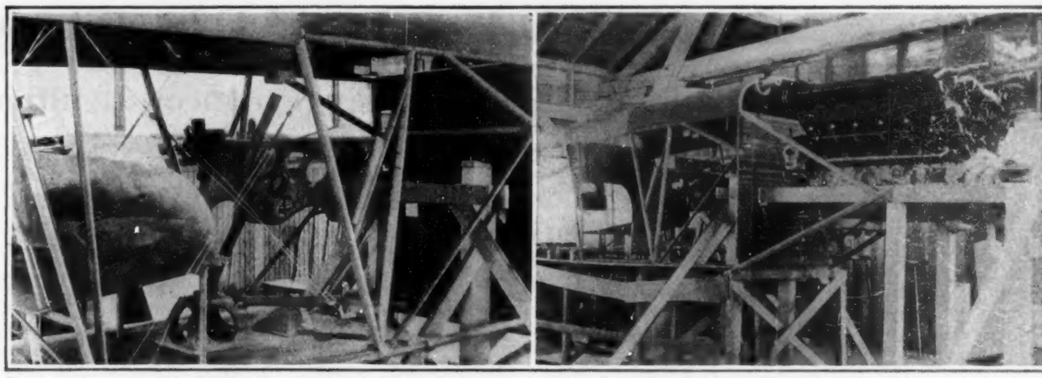
IN solving many of the strictly mechanical problems that arise in modern airplane design, "mock-ups" or dummy airplanes, such as the one shown in the accompanying photographs, are frequently made use of. The construction of the mock-up proceeds hand in hand with and supplements the actual design. It is built largely of wood with all important dimensions to scale. Dummy wings, not shown, are placed in position as the work progresses.

The designer has but to seat himself in the mock-up and he has instantly available a mass of vital information that would otherwise have been acquired only after endless work upon the drafting table and which even then in many cases would have been unsatisfactory.

First: can the pilot see clearly about him? This is of prime importance, particularly with the military airplane. Perhaps the seat will have to be raised or the contour or position of one or both of the wings altered. Are the various control levers and accessories conveniently located? Are the instruments so arranged that they may be observed readily? Is the rudder bar easily accessible to the feet and are there any obstructions for the feet to catch upon? Is there plenty of room to manipulate the stick to obtain full movement of the control surfaces and does the stick, in its extreme positions, strike any part of the plane?

Is the motor readily accessible for repair and maintenance? Where is the best place to run the gas, oil, and water pipes back from the motor to their respective tanks and the motor and radiator shutter control rods back to their corresponding levers? Where is the most convenient location for the oil tank? How best may the light aluminum coweling be shaped to give the desired clean, streamline form?

These and countless other practical problems may be readily solved by the aid of the mock-up.



Two views of a dummy airplane which, although made up of inanimate members, enables the aeronautical designer to see just what he has produced on the drawing board

A Library of Sand

IN the Structural Materials Library of the Lewis Institute, Chicago, Ill., there is a special "library" consisting of 2800 bottles of sand. It has taken over ten years to make the collection, which is constantly being added to. At the present time the collection contains specimens from every State in the Union and from many foreign countries.

It is claimed that this is the only collection of its kind. The purpose has been to make tests to determine the values for cement and mortar work, and to have the findings on record. In each record are included the source of the specimen, the grading, the silt content, and the results of colorimetric tests for organic impurities. In many cases mortar and concrete tests have been made, and the records of these are attached.

A library of sand: Labeled bottles of specimens from all over the United States and many foreign countries

Telescope and Microscope in One

THERE has lately been a revival of the love of Nature and interest in the phenomena of animal and vegetable life which the present generation apparently had all but forgotten. An instrument designed by Carl Zeiss, which is bound greatly to facilitate any kind of nature study, will therefore doubtless appeal not only to scientists but even to the layman with an open eye for Nature's beauties. In fact, this is a prismatic telescope of small dimensions so as to be readily carried in the pocket, but which, by simply attaching to it a tube fitting, is at a moment's notice converted into a microscope. A suitable objective should, of course, be screwed to the tube fitting. While the original telescope amplifies three or six times the microscope produced by its conversion will insure a 42, 84 or 180-fold magnification. The lower part of the fitting carries a miniature table with clamp springs, which is used as a support either of the object carrier or immediately of small objects to be observed, or else in pointing the instrument directly at opaque objects. A reliable fine adjustment serves to bring the objects into focus.

This instrument has proved a most efficient and versatile outfit for the nature student. On outings, it enables zoological and botanical observations of any kind to be made, while the original telescope at the same time affords a means of watching distant objects and manifestations of life, not immediately accessible to the eye. The small microscope fitting is readily carried in the pocket along with the telescope and can be used at any moment whenever the itinerant student of nature wishes to observe small organisms or else histological details on a cut improvised with a minute razor blade. The instrument can as well be used for a study of certain algæ on the spot, possibly in connection with a special chamber fitted in place of the object carrier. The tripod of a photographic camera can be made good use of to carry the instrument, so that the student may keep both his hands free for the manipulation of the optical parts of the device, and the specimen.

Despite its ideal application to the great outdoors, this same combined instrument will render invaluable services at home for leisurely examining the harvest of scientific excursions. In fact, when combined with a special microscope foot in connection with a small lighting device, it will constitute a handy and efficient table microscope. The fact that the experimenter's movements under the microscope are seen in the same direction as actually performed, without any inversion of images, should be considered a decided advantage, and one peculiar to this apparatus.

Finally, the original telescope by the addition of lenses of variable magnifying powers, can be converted into a magnifying glass for use in connection with very far distant objects, thus lending itself for any kind of work in connection with which no simple magnifying glass can be brought near the object.

A telescope and microscope in one. *Left:* Wearing the instrument as a magnifying glass for binocular vision. *Center:* The instrument used as a telescopic magnifying glass. *Right:* The instrument fitted up as a microscope for temporary use

The Effect of Insulin on Bodily Processes

ACCORDING to a statement made by Dr. J. J. R. Macleod at the recent Cincinnati meeting of the American Association for the Advancement of Science, insulin is being used by the physiologist as a new instrument for learning the mechanism of the normal, healthy human body.

A large amount of work has been done on the action of insulin on normal animals, and the immediate effect of its injection is to lower the blood-sugar. This occurs so rapidly as to give the impression that the hypoglycaemia must be due to changes occurring in the blood itself. Investigation has shown, however, that the decrease is due to a rapid disappearance of sugar from the tissues, leading to a secondary removal of sugar from the blood. The cause for the creation of this "vacuum for sugar in the tissues" is obscure; no glycogen is formed in the normal animal following treatment with insulin, contrasting with the effect on the diabetic, and examination of the respiratory quotient does not reveal a marked increase in the combustion of carbohydrates. Instead of glycogen being formed it actually becomes greatly diminished, the reason being, no doubt, that it is being called upon to produce glucose to take the place of that which has disappeared. It looks, at present, as if the sugar disappears by being changed into some substance hitherto undetected by chemical means.

Dr. Macleod stated that glands from fishes have been found to contain large amounts of insulin and that in maritime countries they may prove useful as raw material for insulin manufacture. In this country with its large abattoirs, the more profitable source of insulin is the pancreas of cattle and pigs.

Coal Piles that Light Themselves

Facts and Fallacies Regarding the Spontaneous Ignition of Stored Bituminous

By J. F. Springer

IN the years that have gone, there were persistent rumors that coal would fire itself and that this was the reason for the non-appearance of many ships at their destination. But there remained more or less uncertainty. Naturally, a ship and its crew that never appeared again could not be expected to report just what had occurred. On shore, it is possible that no great amount of trouble arose from this source because of the non-existence of big storage yards for the service of electric generating plants. Today, however, spontaneous ignition is well-recognized as a true scientific fact, and the way in which it comes about is fairly well ascertained.

These points seem to be facts: (1) Bituminous coal absorbs oxygen; (2) this absorption is accompanied by the evolution of heat; and (3) the increased temperature produces a further avidity for oxygen.

Let us imagine a big pile of bituminous coal. All through the mass are voids, filled with air. In the interior of the pile, there will be but little tendency for the temperature to vary because of variations of the weather on the outside. The voids in this part of the pile and elsewhere too will suffer loss of oxygen because of absorption.

The oxygen amounts to one-fifth of the whole, so that, if we assume that it is all absorbed, the remaining four-fifths of nitrogen will have to expand and fill the original spaces. Consequently, this gas will have much less tension than the air which formerly existed. In short, the voids in the coal pile will be at various degrees of tension, but all, except those near the exterior, at less degrees than the normal external atmosphere. We are accordingly to expect a circulation to be set up in consequence of the tendency to get to an equilibrium. The fact that nitrogen has normally a specific gravity lower than that of air would naturally facilitate its exit and promote circulation.

It is believed that there is really a circulation into and out of a coal pile. It has been estimated that nine and one-half hours are required for an entire change of air. However, the period must certainly vary with the rate of absorption if we are to regard the foregoing explanation as correct. But the period named will suffice as being doubtless representative. Accordingly, there will result a circulation, amounting to a complete replenishment of air, two or three times per day.

Some time back an experiment was tried which tends to support the theory of circulation. A pile was provided with a covering having one or more doors or flaps which could be opened or closed at will. When the flaps were open, the temperature rose; when closed, it fell. This seems to show that there must have been a circulation when the openings were uncovered. We may learn a very important lesson from this experiment: when circulation is stopped, oxidation is brought substantially to an end. In fact, if we can stop circulation, we can absolutely prevent spontaneous ignition.

That the absorption of oxygen is accompanied by evolution of heat may be illustrated by the case of a British coal shaft. The temperatures of the incoming and outgoing air were taken at the shaft bottom, and found to be 17 degrees Fahrenheit apart. Why was the outgoing air so much warmer? Well, about 8 degrees could be accounted for by the level of the bottom. This leaves 9 degrees. A small amount of heat could be ascribed to the heat thrown off by men and animals in the mine. However, after all is said and done, a considerable part of the 17 degrees remains unaccounted for, unless we suppose that the oxidation of freshly exposed coal is accompanied by the release of heat.

If coal were simply subject to the absorption of oxygen and the release of heat, we could hardly expect ignition as this requires a relatively high temperature. The circulation which results from absorption tends to lower the temperature. However, it seems to be very true that as coal is heated up, its capacity for oxygen is continually added to. There is, accordingly, a competition between an advancing temperature consequent upon circulation. A consideration of this point prepares us to learn that a combination of conditions is necessary to bring about the result that the temperature increases to the ignition point. Generally, it is only at locations far inside the pile where circulation is assisted but little by the relatively low temperature of the external air that spontaneous ignition will occur.

Two very representative examples of the spontaneous combustion of stored coal

Spontaneous ignition is today recognized as a grim fact that must be reckoned with in the industrial world. Anthracite coal gives no trouble. But bituminous coal is very subject to automatic firing. So real is the danger that the United States Government, when constructing the great coal depots at the terminals of the Panama Canal, provided for a considerable total of submerged storage. Railroads, power companies, and other large users of bituminous coal are often at considerable pains to take measures to prevent self-combustion.

Submergence is a perfect remedy, and perhaps the only perfect one that is also reasonably convenient. It not only prevents circulation, but the low temperature of the water provides against even a beginning of a thermal rise. When large piles are tall and wide, spontaneous ignition is favored, probably because of the protection against heat loss by voids in the interior. Fine coal seems to facilitate self-firing. There appear to be two reasons for this: fine coal means an extensive total area of coal exposed to the oxidizing influence of the air, and the heat released is absorbed by the particles instead of being dissipated into much cooler regions. Some may think that the increase of area is a small matter. This is a mistake. If the lumps of coal be broken up to the point that the new particles are one one-hundredth of the size of the old in respect to all dimensions, then the new surface will be 100 times as great. Fine coal is accordingly to be viewed as dangerous coal.

Thorough ventilation is probably a sufficient remedy provided there are no interior points far removed from a freely moving current. Low piles, narrow at the base, constitute one answer. But what are "low piles," and what is "narrow at the base?" Probably, the permissible height of the pile and the permissible width of the base may be varied with the coal and in consequence of external conditions. A height of twelve feet is probably safe under ordinary circumstances, and a base of ten or twelve feet.

It is rather curious that playing a stream of water on a pile burning down in the interior is not an especially good remedy. The restricted form of combustion upon the inside of a pile tends to promote the formation of coke over and perhaps around the fire. This acts as an umbrella, diverting the downward-percolating water away from the scene of combustion. The approved remedy is to dig out the affected coal. This coal may be promptly burnt or it may be strewn on the ground and subjected to a stream of water.

If, however, the coal is stored in a concrete basin and it is possible to effect submergence at will, then naturally the fire and its surroundings in the pile may be drowned. Actual submergence in water is in fact a thoroughgoing remedy. Some have turned to it. The case of the United States Government has already been mentioned. We may add to this the case of the Underground Railways of London. At Lot's Road, they provided a steel tank of circular plan, capable of submerging 15,000 tons at a time. Another similar case is that of the plant formerly owned by the Omaha Electric Light & Power Company, at Omaha, Nebraska. This concern provided itself with a great concrete pit where it is understood that 6000 tons of coal may be submerged. The present owners write that this pit is almost a necessity because of the kind of coal used. The Duquesne Light Company of Pittsburgh some years ago constructed an enormous basin lined with concrete. The plan area is 150 by 800 feet, and the depth is 25 feet. The bottom is flat, but on the sides are inclines set at an angle of 45 degrees. Here a great body of coal can be submerged at one time.

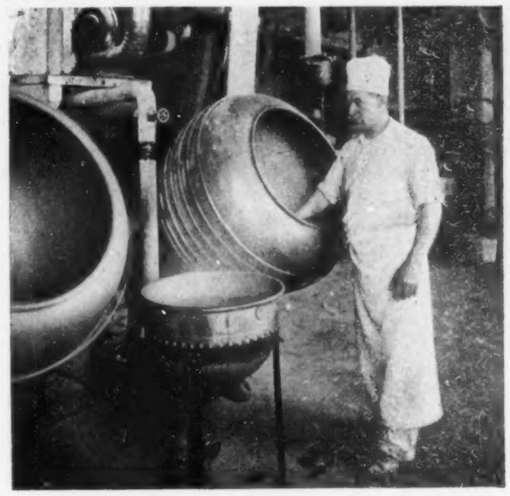
Large users of bituminous coal naturally desire to keep track of conditions, when large piles are employed in effecting storage. Perhaps the best thing to do under such circumstances is to keep continual watch over the temperatures far down in the pile. This may be done by means of vertical steel tubes kept in position at suitable intervals. The lower portions may be provided with numerous holes. The bottom is open and the upper end may project one or two feet above the maximum level of the top of the pile. The open top may be closed by a plug of waste or by a threaded cap. Under these circumstances, it will be comparatively easy to keep tab on the internal temperature. A metal rod may be kept continually in the tube. Upon withdrawing the rod and running the hand along its lower part, one has opportunity to discover any improper warmth. Or, an armored thermometer may be let down by a string and left in position for a proper time to acquire the temperature. Upon its withdrawal, one may determine whether there is anything wrong. Or, such thermometers may be left suspended, one to each tube. A workman may, naturally, walk along the flat top and keep track of the temperature, making his rounds at suitable intervals.

Several rules may appear welcome: (1) Store all coal in low and narrow piles; (2) avoid storing fine coal; (3) avoid subjecting the stored coal to external heat, as the heat from nearby furnaces or the like; (4) increase care and attention where the coal in storage contains sulfur in the form of iron pyrites or contains anything else especially eager for oxygen.

THE phrase "spontaneous combustion" is a familiar friend of long standing; but the average person might be pardoned for feeling that it represented merely a convenient alibi to cover the fires that can't be explained in any quicker or easier fashion. The fact is, the conditions under which coal will ignite itself, to burn more or less vigorously, are fairly well determined, and the means of prevention fairly well indicated. It is these two questions which Mr. Springer discusses in this story.—THE EDITOR.

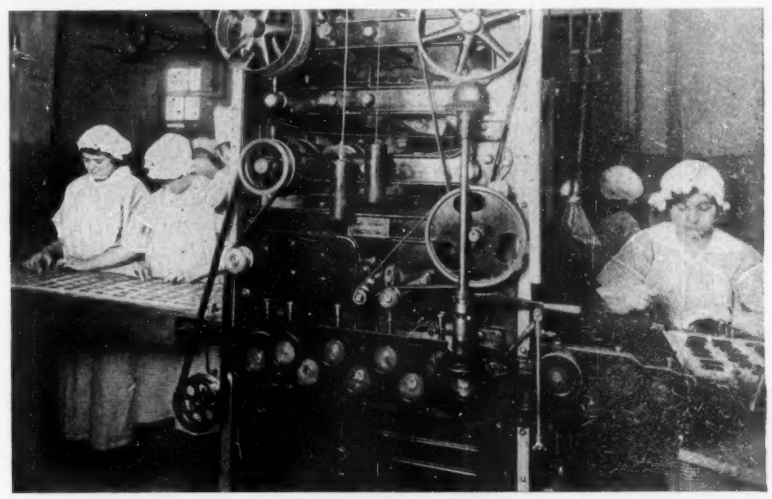
Cocoanuts come to the candy factory in bags. The shell is removed and the cocoanut milk is allowed to go to waste as it does not enter into candy manufacture. Real manual expertness is acquired in removing the shell so that the white meat is not wasted. The cocoanut palm is found in most tropical countries. For commercial purposes the palms are raised in plantations or "groves" and it is estimated that there are many millions (one authority says 10 billions) in cultivation. In the nut department of a candy factory the almonds, pecans, peanuts, hazel nuts, walnuts, Brazil nuts and many rarer varieties are sorted and picked so as to remove all particles of shell. The nuts are imported shelled, as labor is so costly here. Jordan almonds are scalded, passed through an ingenious machine where rubber rollers remove the skins, then roasted and salted

After sugar the greatest material used in candy manufacture is undoubtedly chocolate, and here we see the chocolate mill. The roasted cocoa beans are shot through tubes into the hopper and are ground into a liquid mass without adding anything at all. The cocoa beans contain about 50 per cent of fat, and the cocoa butter liquefies in the grinding process. The cocoa liquor, as it is called, is placed in large mixing machines where specially powdered sugar is added in the proper quantities with the flavoring of vanilla. The chocolate mass, for a mixture of cocoa, sugar and vanilla is called "chocolate," is ground and mixed by means of granite rollers, melted in iron kettles and moulded in cakes of from 10 to 100 pounds



Sugar coated almonds are coated in the machine shown in our engraving. It is really a huge copper kettle turning on its axis so as to tumble the almonds around and combine with the syrup. It may not be generally known that the candy factory has an artificial atmosphere. This is why amateurs fail in candy-making. Rooms are cooled in summer by refrigeration and are warmed in winter to the proper temperature. Some processes of candy-making require one operation to be carried on in a warm room and the next in an artificially cold room, and, as you watch them, the candies on an endless belt are whisked away through a "hole in the wall" into a refrigerated room. There are many days in summer, when a large part of the factory is cooled

Sugar cream is the basis of many candies. In the cream department we find a row of large copper kettles heated by high pressure steam. The sugar syrup, after having been cooked to the proper consistency, is poured on round iron tables where it is allowed to cool off. After it has cooled off to a soft mass the ingenious mechanism mounted on these tables begins to function. By means of this mechanism the mass is kept revolving and becomes stiffer and stiffer as well as whiter and whiter until the observer recognizes the creamy sugar mass which forms the center of most chocolates. The cream is then remelted, flavored and incorporated with other substances, and is then cast into starch impressions and when sufficiently hard is separated from the starch. The centers are then ready for coating by hand or machine



The chocolate coating machine completes the candy. The center may be the cream centers or may be any of the other types of candy such as flat pieces of butterscotch. The center is put on wire feed belts and passed into coating machines or enrobers as they are called, where the centers are coated with chocolate by means of a constantly flowing stream of liquid chocolate. When they come out of the machine at the other end they are thoroughly covered but still warm, and must therefore pass into the refrigerating room, to be taken off when dry. It is a constant performance, centers going in at one end and finished chocolates coming out at the other end. Ton after ton comes through every day. The chocolate is melted in huge kettles holding 600 pounds, and the large cakes are used. The best chocolate is aged for months

Molasses candy is the old standby and is beloved by all children. It is a type of candy which can be made in the home. It is often made in a store window, the sole machinery being a large galvanized hook. In the candy factory the process is expedited by a "pulling" machine which gives an immense and absolutely uniform product. The rotating arms have straightened out hooks, as they might be called, and they interlace so that the batch of golden-brown candy is roved back and forth, until it is finished

Lemon drops are made by a simple machine which is typical of most hard candies. The sugar is boiled in open kettles or under vacuum, and after being boiled it is divided into separate batches and poured on large iron slabs which are cooled by means of water circulation. The various flavors are added and the batches are then pulled by the candy-makers on large iron hooks. The candy is reduced usually to the form of a wide ribbon which is cut into form by means of various machines according to the shapes desired. Cutters, rollers, and presses are used, depending on the nature of the finished candy

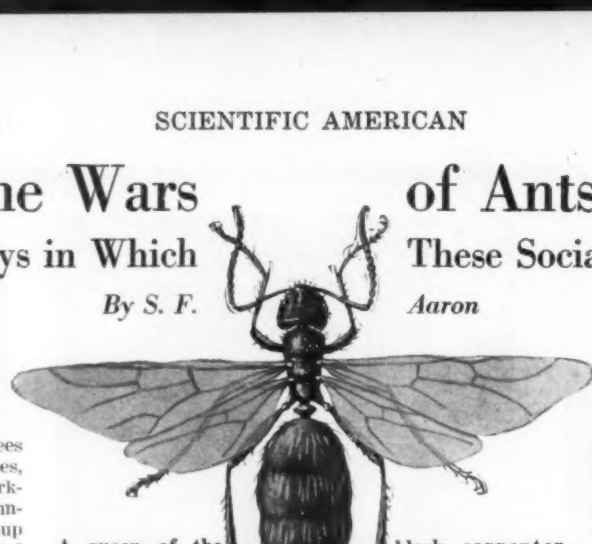
We have seen how centers have been coated by machines which are almost human, but there are certain candies which are made by hand and our view shows a girl dipping bon bons. Each girl has a steam-heated copper pot similar to a cereal boiler. The pots contain the flavored soft sugar, and by means of a special fork the girls dip bits of fruit or nuts into the creamy mass, place the now formed bon bons on wax paper and form fancy strokes by means of the fork

FROM COCOA AND SUGAR TO BON BONS: CANDY IN THE MAKING

The Wars of Ants

Reasons Why and Ways in Which These Social Insects Battle

By S. F. Aaron



A queen of the black carpenter ants, drawn approximately three times natural size. To the absence of queenly judgment in locating nests near existing colonies much of the ant warfare may be attributed

NO CREATURES, including the wise and busy beavers, so nearly approach mankind in cooperative organization as do the ants; they are more varied in their efforts and interests than the bees or social wasps. Though the Termites, close relatives to the nerve-winged order, very remarkably possess habits similar to the morphologically unrelated Hymenopterous ants, it is alone the latter group that shows a warlike animosity toward tribes of related and equally powerful species.

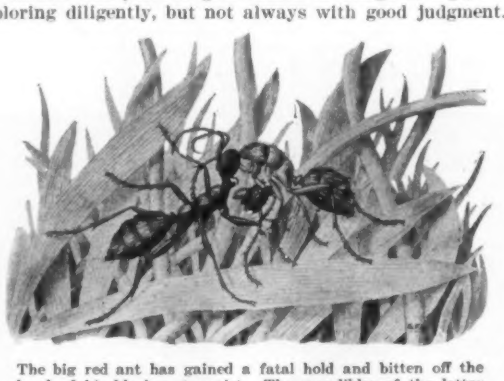
In all worthy accounts of warfare there is given a history of the causes that have led to it, the motives, influences and situation of the contestants. Let us then inquire in this instance as to what led to this death-dealing desire on the part of two tribes previously devoted to the arts of peace and the gaining of plenty. We may not be surprised to find that these gentler habits have, as is often the case, caused trouble through that horrible tendency to covet, the desire to acquire what other and supposedly weaker colonies have gained. Nations of mankind have bitterly demonstrated this and we can hardly expect more altruistic sentiments from insects.

Among all the hosts that comprise the flourishing colonies of Formicid ants, always busy throughout the warmer seasons, it is the queens that are the pioneers; they alone establish new colonies. The wingless worker ants, no matter how far they may wander, always return with or without provender to the tribal home where they are born. It is their inherent duty to make the colony habitation a livable place, there to serve their several queens and princesses, to play nurse maids to the coming generations and to labor continually for the good of the tribe.

Unlike the social bees and wasps there are many queens in the ant nest that get along amicably, but after a time other winged princesses are born and grow up and some of these evidently recognize that there is too much divided authority, or else there are not enough worker subjects to serve their needs along with the rest.

Then when comes this old urge to get away and start anew the princess takes to her wings, followed by a host of idle admirers, also winged. But she is without a retinue of worth-while adherents; there are no servants to aid her effort. What then must be done to assure success for her pioneering venture? That is soon decided.

Hither and yon she goes either on wings or legs, exploring diligently, but not always with good judgment.



The big red ant has gained a fatal hold and bitten off the head of his black antagonist. The mandibles of the latter retain their hold of the victor's leg

Formicid warriors in single combat

She may pop into a woodpecker's nest and be gobbled; a fly-catching bird may snap her up as she labors through the air from grass stalk to tree trunk. She may survive and find a most inviting spot: the cavity under a wide root too small for even the long-tailed shrew to enter, a deep crack in a rock as desirable, an old wood-boring beetle larva burrow in a log with but one round, small entrance, the deserted and intricately-chambered nest of a field mouse on a low knoll, dry and ready. But she may overlook one thing: the proximity of another ant colony, not of her own tribe or kind, but of a feudal race.

The colony site is chosen; the princess drives out the idlers who try to swarm after her, accepting only one princely fellow as her consort; she has then become queen of this lonely domain, but being without subjects does not daunt her. At once she commences to clean house, especially that part of it which seems best for a nursery. Some eggs are laid, the tiny, helpless little antlings hatch and the mother feeds them. In less than two weeks of early summer weather these babies have grown to adult size; around their bodies they spin stout, elliptical, silken cocoons which the queen carries to places affording the greatest moist heat. In another day each becomes within this sack a whitish-yellow creature that looks more like the ghost of an ant. Another week passes and it cuts open the cocoon, emerges, takes on color, stretches its legs and in a few hours is running about.

Is heredity the sole teacher of these busy gleaners, housekeepers and nurses? Probably; there seems to be no evidence of their going through a course of training, nor of doing anything even by example of others. At the very hour of their gaining their complete powers of movement, as soon as they are able to run about and use their legs, jaws and antennae they go to work, assigning themselves various duties without an apparent foreman or commander. Presently some of the eggs hatch other princesses who in turn become queens, giving all of their time to idling or the laying of eggs so that, before the summer is half gone, the colony has increased to several thousand inhabitants, unless there is some disturbance, as that of being dug out by a hungry woodpecker, grouse, or opossum. Perhaps disease in the form of a white fungus that clogs the poor creatures' bodies and chokes them to death, will deplete the colony. Generally, however, it survives wonderfully well all minor mishaps and that is why ants are perhaps more plentiful than most other insects.

Two colonies of the same species of ants do not disagree; they may not fraternize, but each goes about its own business. Colonies of different races, or more correctly termed different though related species, possess ancient hatreds for each other that invariably, if the colonies happen to be located within ranging distance of the workers, result in warfare. The ranging distance may be at least ten yards, even for medium-sized species of ants.

The pioneer princesses go at this home selection business blindly; having eyes that admit very little light this is not surprising until we consider that ants are governed entirely by wonderful powers of smell and when they overlook the nearness of an enemy colony we might say that they act noselessly if it were not that they do not possess noses, but receive odors by the antennae.

Perhaps the pioneers are indifferent to the nearness of a foe, for they can hardly anticipate a contest. However, with the growth of the colonies the widest rangers soon discover the location of an enemy tribe and a foray is considered. Every colony holds within its nest many undeveloped young larvae and pupal cocoons and these make fine food for the young of the covetous colony. Cannibalism! In spite of their highly meritorious, peaceful occupations ants are thus depraved.

Are the limited mental powers of ants capable of considering anything? Some biologists and others who have not delved very deeply into the secrets of the out-of-doors say not so. But we have yet to learn and comprehend much concerning the processes by which animals of all the highly developed kinds arrive at conclusions. Ants do make decisions, for in some instances, after discovering an enemy colony distinctly

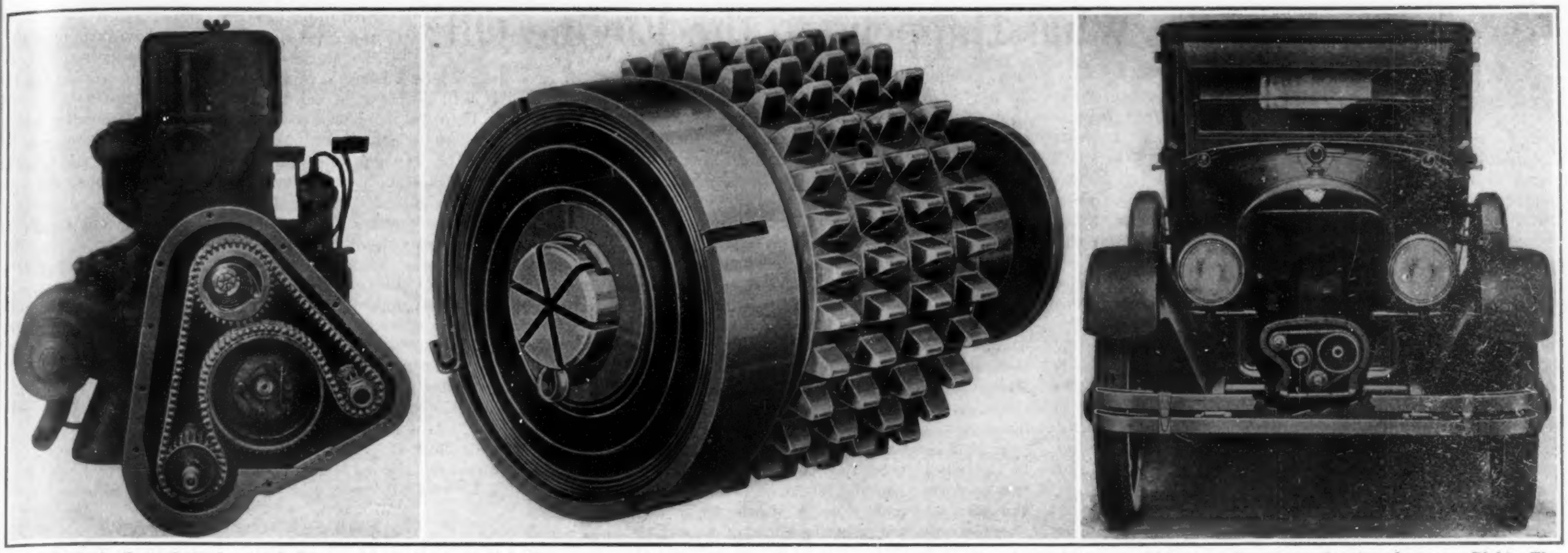
(Continued on page 144)

The amazon with its powerful jaws fastened upon the body of the foe will give the death wound, perhaps severing the abdomen at the slender waist. It as often happens that the red ants are the victors, their colony outnumbering the blacks, with which they have a hereditary feud

Black carpenter ants killing a big red ant by force of numbers

The upper ant carries a young larva of a red ant, which the captor will take to the top of the grass stalk and down the other side, with the idea of making progress. The middle warrior drags a pupa that has become somewhat entangled, and the lower ant has captured an enemy cocoon which may contain a full-grown larva or pupa

Black carpenter ants returning to the nest with the spoils of war from an enemy colony



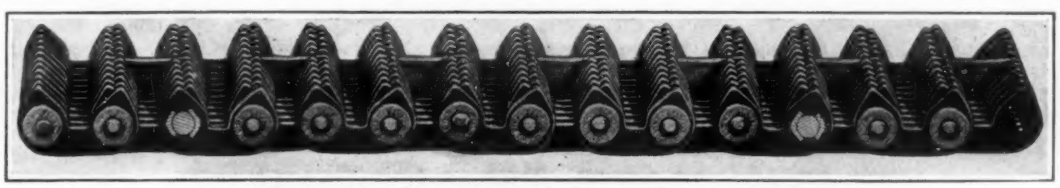
Left: Typical silent chain front-end drive, with spring-controlled idler (top sprocket). *Center:* Close view of the automatic chain tightener which acts also as a vibration damper. *Right:* The tightener and damper as installed on a car famous for its speed on the road

The device for automatic adjusting of the front-end drive, which turned out also to rob the engine of much of its vibration

Taking the Period Out of the Automobile Engine

PERFECTION in automobile engines will be very close to attainment when vibration is entirely eliminated. Year by year improvements in this direction are being made as we learn more and more about the causes of vibration and consequently are able to remove them. A very interesting development in this direction has recently taken place and bids fair as a result to aid materially in eliminating troublesome vibration periods which have been found to affect certain engines.

It is usually found necessary in laying out the chain for a front-end drive, as the camshaft and generator-shaft drive on the automobile engine is commonly known, to provide some form of adjustment to compensate for the normal wear which takes place in the joints and bushings in the silent chain. The chain itself is also subject to a certain amount of stretch which has to be taken care of. To adjust a chain properly is rather a delicate operation, as the layman is often tempted to stretch the chain too tight, causing it to howl and lose the very benefit of silence for which the chain is intended. Too loose a chain may not only be noisy, but has been known actually to jump or skip a tooth in the sprocket, throwing the relationship of the timing out so far that the car may be actually stalled. To overcome this difficulty one of the large manufacturers of silent chain has devised an automatic take-up in which the chain is continually acting against the tension of a coil spring which is set to put just the proper amount of tension on the chain. This automatic take-up is contained within an idler sprocket over which the chain runs, often with the back of the chain bearing against the idler sprocket containing the automatic take-up. The chain is designed with reversed links so that it can mesh with the sprocket wheels on either side.



Center-flange silent chain, typical of those used on front-end drives

When this installation was first fitted on engines it was done with the sole purpose of performing the function described; that is, to keep the slack out of the timing chains. Engineers, however, were surprised to note that in engines which were troubled with bad periodic vibrations that the installation of the automatic take-up had a marked effect on dampening these vibrations. A study of why this should happen has led to a clearer picture of what makes an automobile engine vibrate than many engineers have ever held before.

The flywheel is usually mounted on the rear end of the crankshaft. It is not hard to picture what happens when the first cylinder—that is, the one at the front end of the engine and farthest away from the flywheel—has an explosion. The force of the explosion drives the piston downward like a projectile against the crankshaft in a tremendous effort to cause the shaft, by means of the leverage on the crank, either to rotate or to bend. The crankshaft, being elastic, does both. It rotates, delivering the power back to the drive; but owing to the inertia of its mass and the mass of the heavy flywheel and the car itself when driving, it also bends.

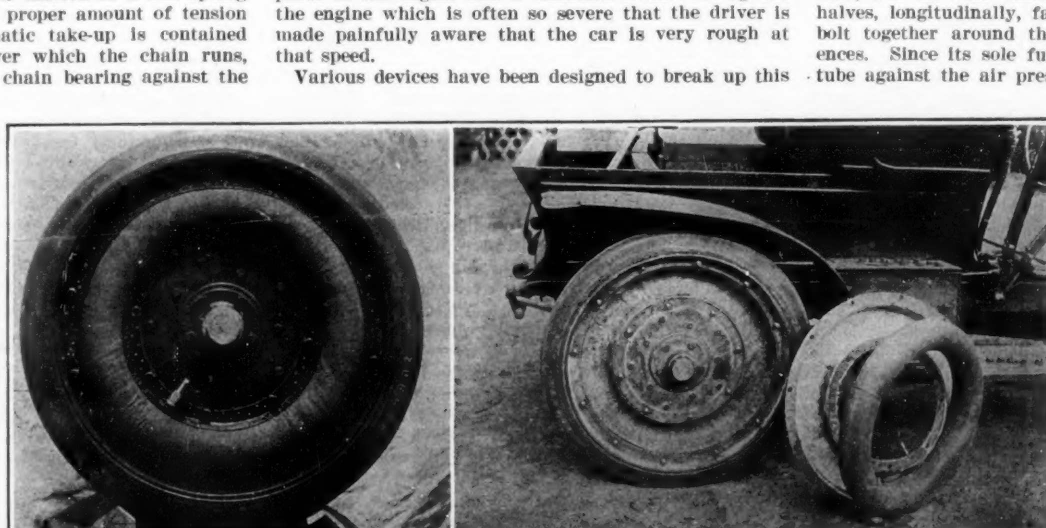
Being elastic, after being bent the crankshaft flies back into place. If the shaft is long and thin it bends further and slower and flies back likewise slower, and if it is short and thick it bends a little and flies back rapidly. Engineers interpret the amount of bend and the rapidity with which it flies back as the natural period of the shaft. At certain speeds the bending and the recoil tune in with the natural periods of other parts of the engine and a vibration occurs throughout the engine which is often so severe that the driver is made painfully aware that the car is very rough at that speed.

Various devices have been designed to break up this vibration. They have the failing that they allow the vibrations in angular velocity in the crankshaft to be transmitted through the front end drive to the camshaft and generator-shaft. The sharp jerk that the recoil of the crankshaft imparts to anything solidly connected with it is a serious cause of stresses on the engine parts and a cause of vibration. It must be re-

(Continued on page 144)

Putting the Tire Inside the Wheel

PNEUMATIC tires are very fine indeed, reasons a French inventor, so long as they remain pneumatic. But when the unexpected puncture or blow-out occurs, the driver who chances to be so unfortunate as to be at high speed at the moment stands an excellent chance of smashing his machine and himself. Moreover, the pneumatic tire tends to defeat its own cushioning aims by presenting so small a surface of contact to the road at a given moment, so small an area of rubber and volume of air to take up a given shock, that the jar must necessarily be transmitted to the car through the excessive reaction. So the inventor in question has given us a new design of wheel, with the rubber and air inside, as indicated in our two photographs. There is the usual hub assembly, and the usual rim; and there is a thin shoe of solid rubber to take care of contact with the road, with its inevitable wear. Between the two there is the "tire," consisting of the familiar inner tube, and an outer shoe. This shoe is made in two halves, longitudinally, faced with metal flanges which bolt together around the outer and inner circumferences. Since its sole function is to support the inner tube against the air pressure, while it is entirely free from mechanical wear, it may be much more cheaply constructed than the present shoe, and particularly it need have no tread. The placing of the tube inside the shoe is a very simple matter compared with the present wrestling match involved in getting a shoe on a rim; and the freedom from puncture and blow-out insures that once in, it may remain in a long time. Finally, the inventor claims that the entire lower half of the tire is in play at every given moment, so that there is a much more gentle and effective absorption of all shocks, even though solid rubber is in contact with the road surface.



The cruller-shaped ring in which the inner tube is carried is of rubber-fabric construction, like the present shoe; but it is in a place where punctures and road-blowouts are impossible. Also, it is claimed to give better cushioning there than when it is outside the rim

Two different, partly assembled views of the latest French automobile wheel

What Happens to the Engine Oil?

HAVING come into possession of a car, the one item of expense attached to its upkeep which is really noticed is that of oil. By the word oil is meant lubricant and fuel. These two go together, and their consumption is interdependent more today than at any time in the history of the automobile. In this story we shall think of the lubricating oil principally, and try to understand how it is that the gasoline of today has such an effect both on the friction loss in the engine and the money we must spend on oil if we want to keep the engine properly lubricated.

What is known as crank-case dilution is one of the most important factors governing the economical operation of an automobile today. When we obtained light gasoline in the early days, there was no such thing thought of as dilution of the oil by the fuel. The fuel vaporized readily, and even if some of it did not do so in the carbureter or in the manifold, as soon as it reached the hot cylinder and piston, it became gas and mixed with the air. Those times are past forever because of the growth of the use of the automobile and the need for fuel. The refiner is now put to it to get all the fuel possible for automobile use, from each barrel of crude oil. Much of this lower-grade fuel does not vaporize unless it is made very hot or drawn through the manifold at a very great speed. But there are many conditions of working when the engine is cold, as at starting, and when the air and fuel only creep through the manifold, causing the fuel to run down into the oil.

The body of an oil is called its "Viscosity." This really implies its resistance to flow; we would say that syrup was more viscous than water. But water has about the same viscosity when it is hot as when cold. Oil is very different and is most sensitive to temperature. Another point about oil is that it loses its viscosity very fast when the first lot of gasoline mixes with it, but further additions do not thin it down in the same proportion. It is very difficult to tell by the feel or appearance of a used oil, just about how much it has been contaminated or how much more it would stand before it fails to be any good as a lubricant. So much depends upon what was the original state or viscosity of the oil. A very heavy oil will show its loss of body very quickly, while a thinner oil may appear to be quite near its original condition, even though it may contain more fuel than the heavier oil.

Up to now nobody seems to offer a definite suggestion as to how much fuel can be allowed in oil. It is quite usual to find 25 to 30 per cent in the Winter and 5 to 10 per cent in the Summer. It is the writer's opinion that the nature of the oil has far more to do with the matter than any exact percentage of dilution. An oil that is greasy, or contains certain lubricating properties, will be just as good a lubricant even when much diluted, as when new. It will, however, have lost some properties such as holding compression at the piston rings, and may make a noisy engine.

The condition of the engine has much to do with this question of permissible dilution, so far as the immediate result is concerned. A badly worn engine relies on the body of the oil to do many things that properly belong to the pistons, cylinders or rings. With a good condition of surfaces it only takes a very little oil to keep down the friction, the thinner the better within limits. Of course, very thin oil leaks out worse than thicker, or more viscous oil. A condition may arise when there is a good deal of chatter from the working parts. This is caused by irregular contact and surfaces which are not uniformly oiled. There may also be some water in the oil, which has come down from the combustion chamber originally in the form of vapor. If water gets on a surface first, it is very difficult for the oil to get there unless the oil contains matter which enables it to emulsify or form a froth. Some oils do this. The addition of a small amount of rape oil or of some of the oils from other seeds or nuts will generally prevent chattering. The effect of this added oil will be to make the original oil flow more freely, it will make the oil stay on the surfaces of the metal longer in the form of a very thin film.

The most serious result of water and gasoline getting into the oil is due to the amount of dirt which they carry with them. Some of this is washed down the walls of the cylinders, road dust and grit from the tops of the pistons. In addition the deposit of carbon and dirt which is always on the inside of the pistons, is loosened and drops into the crank case. All this acts as a grinding material; some engines will show as much as 25 per cent of solid and asphaltic matter in the oil. If the oil could be kept clean, that is free from grit, it would last in useful condition very much longer than at present. No matter how bright or pale the oil is when put into the engine, it soon looks black due to the very small particles of carbon which collect. This very small carbon does not do any harm just so long as it is not gritty. No kind of filter used in an automobile will hold up the grit entirely; the best material to use is a woven fabric or cloth. To make a job of cleaning the oil, it should be passed through several thicknesses together; it will go through more quickly if it is hot.

Dilution can best be minimized by observing some care in driving, particularly at starting. More trouble can be caused by holding out the choker for a few minutes than can be remedied in a long time. In less than a minute half a pint of gasoline can be thrown into the crank case by this means. Even the best piston rings cannot be expected to stop it all. Idling the engine for long periods will also cause flooding and always a cold engine will be worse than a hot one.

Carbon deposit is mostly road dust. If the oil which is used gets gummy when hot, the dust going through the carbureter is caught by this gummy oil and held on the pistons. Some oils, those which contain much cylinder stock, form hard cakes of deposit, other oils deposit in small pieces or grains, which are generally dry. As long as the heads of the pistons keep dry, with this kind of oil, there is not much deposit formed. In any case the adjustment of the carbureter on the lean side will help very much to reduce deposit forming.

Spores in the Upper Air

BY the use of the airplane the contents of the atmosphere at high altitudes can be studied. Recent investigations have been made by the office of cereal investigations of the United States Department of Agriculture in cooperation with various State experiment stations to ascertain what part the air plays in spreading the spores of plant diseases. By equipping airplanes with spore traps it was possible to make collections of spores at various altitudes. Aerial explorations were thus made in Texas, Nebraska, Wyoming, and Minnesota. The spore traps that proved most successful consisted of slides treated with vaseline placed in compartments in a mechanical spore trap attached to airplane, so that each compartment could be exposed and closed at will.

Discussing the results Elvin C. Stakman says in *Journal of Agricultural Research*, Vol. 24, No. 7: "Spores and pollen grains were relatively abundant at altitudes up to 11,000 feet. They were relatively scarce at higher altitudes but two spores of what appeared to be Puccinia triticina were caught as high as 16,500 feet.

"The airplane is a great aid in studying the distribution of spores of pathogenic fungi. It is likely to be very useful in epidemiology studies."

New Uses for Rubber Milk

RUBBER milk, or rubber latex which is the more common term, is the juice of the rubber tree from which crude rubber is made by coagulation with the aid of acids or smoke from burning rubber tree leaves. This substance is now a regular commodity on the market and is used by rubber makers for various purposes, such as the dipping of fabrics in the manufacture of rubber tires, impregnating textile materials for many uses, etc. But the real interest of rubber latex to the layman, who is not concerned with rubber goods manufacture, is in the many applications to which this strange, exotic substance can be put in fields that are not connected in any way with the rubber industry.

For example, the glazier and painter know well the drawbacks that are possessed by ordinary putty. This is a mixture of whiting calcium carbonate in finely divided condition, and common linseed oil. It is ordinarily used for holding glass windows in their frames. But after the putty is dry, it falls out very easily. It seems to possess no adhering power to the wood or the glass in the dry condition. The result is that the pane of glass is apt to fall out and break. But when rubber latex is used in the place of linseed oil in making putty, a cement is obtained which will stick both to glass and frame indefinitely and moreover provide an absolutely waterproof joint in the window.

Many substances are used in making mattresses and in the upholstering of furniture. Grasses of all sorts, feathers, straw, hay, wood meal, sawdust, cotton, wool, hair of various origin are some of the materials used for this purpose. Some are of animal origin and hence will be eaten by moth larvæ. Practically all of these substances lose their elasticity after comparatively short usage. Furthermore, certain of these filling materials are unsanitary, especially when they are packed tightly and do not allow the free passage of air. All of these disadvantages are overcome when the stuffing is first impregnated with rubber latex. Thus straw or hair may be treated in this manner and after impregnation the rubber may be vulcanized and a perfectly elastic stuffing is obtained.

Furniture that is over-stuffed with this material will retain its shape indefinitely, as the rubber-treated stuffing will keep its elasticity for a long time. Woolen stuffing and other similar animal substances treated with rubber latex cannot be destroyed by moth larvæ. Furthermore, it is not necessary to use so much of this stuffing, for the elasticity is considerable and hence there is plenty of air space within the mattress or the upholstering which enhances the circulation of air through it and promotes the sanitary properties of the same. Finally the rubber-treated stuffing may be removed and cleaned by washing with hot or cold water and then put back into the cushion, etc., again in just as good condition as when first used.

Another interesting use for rubber latex is in the manufacture of composition corks and bottle stoppers. It is cheap and simple to steep the wooden cork into latex and secure thereby a perfectly air-tight stopper. Composition cork products can be readily manufactured from a mixture of cork dust and other solid ingredients with rubber latex. It is claimed that a better product, more elastic and stronger, can be obtained than when glue, gelatine, pitch, linseed oil and other binders are employed for the same purpose.

It is comparatively simple to glue together two pieces of wood, but there are materials that are not so easy to glue together. Thus, for example, it is rather difficult to fasten metal to glass, waxed cloth to wood, paper on metal, wood on glass, mica to mica, etc. It has been found that when the cement is made with rubber milk, these materials can be firmly fastened together and what is more a perfectly waterproof joint is obtained. The rubber cement can be employed in gluing labels to metal boxes, wood and brass, brushes into wooden handles and holders as well as into metallic holders, for waterproofing barrel staves, fastening maps to a wooden under-surface and then for waterproofing the map itself, in the manufacture of writing desks and tablets, etc.

A very interesting use for rubber latex is in the manufacture of violins. According to Rudolph Ditmar, who has done pioneer work along these lines, when violins are made from wood, which has been impregnated with rubber latex, instruments are obtained which compare in quality of tone with the old Italian masters. The effect produced by the rubber latex seems to be in the provision of an elastic background which gives forth a tone of high quality when the bow is drawn across the violin strings.

There are many other uses suggested for rubber latex which cannot be gone into in any detail here. Among these may be mentioned its use as a cement binder in linoleums, oil cloth, composition flooring, wall boards, etc., in the mixing with paper pulp to make composition articles, such as toilet seats, handles, etc., for conserving and waterproofing of building materials such as sandstone, gypsum, concrete and plaster by making a waterproof paint; for making water-tight pipe joints in the place of red lead and linseed oil; in waterproofing cases and cartons, etc., etc.

The field has just been merely scratched. There are many possibilities of using rubber latex which are still unknown. In connection with its use, it must be remembered that its properties are those of a binding agent, that it will hold together particles of solid matter and form with them a firm, hard, elastic, strong mass. Wherever there is needed such a substance there will be found a use for rubber latex.

A Large Employer

HENRY FORD is a very large employer of labor, having 162,792 names on his payroll. They do not all work in Detroit, however, as 121,214 are employed in manufacturing plants of the company at Detroit and elsewhere in the United States; 24,323 in the American branches, and 11,028 in foreign lands. In addition to those employed by the Ford company—a total of 156,565—there are 2,525 men employed on Ford's D. T. & I. railroad, 2,282 workers in Fordson coal mines, 720 men at work at the Henry Ford Trade School and 700 employed at the Henry Ford Hospital at Detroit, according to the latest available figures.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Glass-surfaced metal construction that makes possible vacuum bottles with capacities measured in gallons

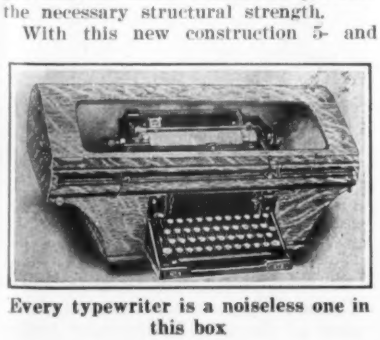
Bigger Vacuum Bottles

HIGH vacuum is the best insulation known to science against heat or cold and ever since Dewar invented the first vacuum bottles for the storage of liquid air other inventors have tried to construct glass bottles and metal bottles of large size but without success.

The two-quart size is still the largest glass vacuum bottle manufactured, because the thin glass construction necessary for the heat expansion and contraction has made larger sizes too fragile for commercial use. Double-walled all-metal bottles have also been impossible because once they were evacuated it was found that there was enough gas given off from the vacuum-wall surfaces to fill partially the vacuum space, which produced a low vacuum and resulting poor insulation against heat or cold. Only platinum and one or two other of the very rare and expensive metals have been found without occluded gases on their surfaces, and their great cost prohibits their commercial use; but glass has been found to have almost no surface gas.

Now a new invention combines the glass surface and the metal walls, making possible huge sized vacuum bottles and wide opening containers as shown in the illustrations. Thin open-hearth sheet steel is made into the desired shapes, there being two walls to each container, the inside just a little smaller than the outside; these parts are then separately cleansed (pickled), coated with liquid glass, and baked at a very high temperature until the glass is perfectly fused to the metal surfaces. When once the space between two flasks of such construction is evacuated, it stays evacuated; the glass surface gives off no gas and the metal foundation provides the necessary structural strength.

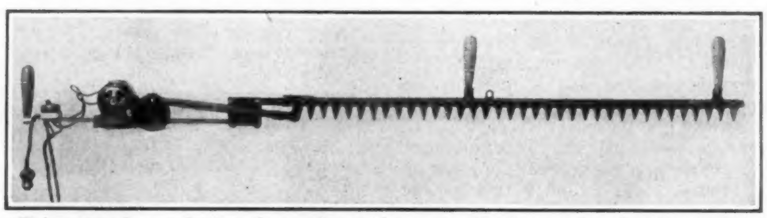
With this new construction 5- and 10-gallon vacuum containers can be made to deliver ice cream by express or interurbans to distant places without ice and at a very great saving, as the shipping weight is less than half the iced method. Oysters, milk and cream can also be delivered to distant places in the same way, and numerous other uses found for the big vacuum bottles.



Every typewriter is a noiseless one in this box

A Better Tool for the Hedge Barber

ONE person can control the smaller (40-inch) size of the new hedge trimmer illustrated; while for larger work a 60-inch size comes that is intended as a two-man job. It is guaranteed to trim from 300 to 500 feet of hedge an hour, trimming top and both sides. It is driven by a one-tenth horsepower electric motor, operating on either direction on alternating current. An easy tumble switch, right under the operator's finger, makes control simple and instantaneous. For current supply, a special water-proof extension cord is furnished in 100-foot lengths, to reach to any convenient light socket. Where the hedge is a really ambitious one, running several hundred feet from the nearest building, permanent wiring is recommended, with outlets every hundred feet or so; and this may be concealed within the hedge itself for aesthetic and practical reasons.



Trimmer of new design that reduces the care of hedges to its simplest terms

"Stop That Typewriter a Minute!"

THE pretty bob-haired secretary who hears this and obeys every time the 'phone summons the man who can't concentrate should find a way to cage up the noisy machine in a box. And here is the very box—not a mere makeshift, either, but a regular, standard product of a well-known typewriter manufacturer. Offhand, one might be disposed to make facetious observations about manipulating a typewriter in a box being a sort of a bother. The writer, who certainly is not interested in the sale of this or any other typewriter attachment, thought so. But after a trial test of the box he liked it. It seemed quite practical and everyday usable.

The box has a hinged top, but it is not necessary to lift this top. A slight pressure of the left thumb on a button causes it to rise—not to pop up like a Jack-in-the-box, but rather calmly, for it is controlled by a small air-piston. All the work of spacing, etc., is done without raising the cover, however. Appropriate levers extend through a long, narrow slot, this slot being lined top and bottom with soft deep felt having "whiskers." These fill in around the levers, keeping the sound in, but not preventing motion of the levers.

Not only does the box keep noise in, but it keeps dust out, a decided point in its favor. Of course, one can hear the striking of the keys—it is hardly that quiet, nor could it be expected to be. It does, however, make "all the difference in the world" with the amount of racket that gets loose to pester people who like to be able to hear themselves think. The device might even keep the boss's temper sweeter, while if used in the home it certainly won't awaken the baby.

A Jammed Key

ONE of the cleverest methods for removing a jammed key, broken stud, etc., which we have ever seen is contributed by a reader of the *Practical Engineer*. The recalcitrant stud was drilled longitudinally with a hole of convenient size; and this hole was tapped with a left-handed tap. On reaching the bottom of the hole, the tap of course in turn jammed; and naturally, as it was turned further, the stud was pushed slowly from its seat.

A New Launching Device That Halves the Power Needed for Airplanes

AIRPLANES must have heavy engines to be able to get off the ground, or to "take off" as the aero engineer calls it. Once aloft, the machine can keep on flying with little more than half the horsepower needed for taking off.

Commercial airplanes need very powerful engines at the present time, and this means a heavy structure of body and wings, as well as a great deal of fuel for the trip.

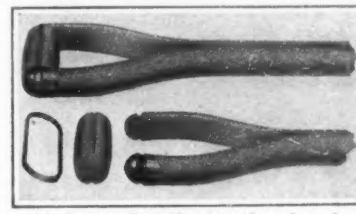
German engineers have brought out a new device, which launches the machine into the air by a powerful hydraulic piston; the motor fitted to the airplane is quite strong enough for maintaining the machine in flight, but too weak to lift the machine into the air.

With this dévice, the rentability of commercial airplanes is assured, as the whole machine becomes much lighter and less fuel has to be carried, so that a greater percentage of the lift can be utilized for passengers and goods.

When starting, the landing chassis and wheels of the airplane are withdrawn into the body, and the machine is placed on a carriage which runs on a starting track. The hydraulic piston forces the carriage along the track with great speed, and when arrived at its end, the machine is launched into the air.

The recent gliding experiments carried out in Europe showed clearly that by far the greatest energy was required for starting a glider, and that, once in the air, a glider can be kept aloft with an incredibly small amount of energy.

The new starting device, which will soon be put in operation in Germany for the machines serving the central Europe lines, will allow the constructors to carry greater loads and more passengers with smaller engines and less fuel by applying the experiences made with gliders to power-propelled commercial airplanes.



A better handle for the shovel

Old Ideas Made New

TWO facts taught and used years ago are the principal features in a new shovel handle now being placed on the market. One of these ideas is that a stick of wood is much stronger when a strain is placed against the grain than when applied with it. As a boy we were told to hit the ball against the grain of the bat—not with it. If we didn't—"crack" went the bat.

The second idea comes from the hub-band of a wagon wheel. To produce the strongest grip for a band—the blacksmith shrunk the iron or steel band on the hub. It never gave way.

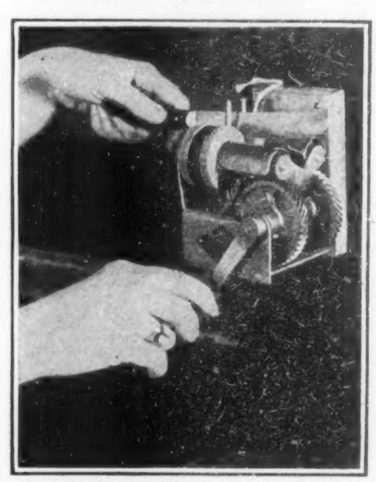
With this new shovel handle, the grain is perpendicular to the blade or grip and the strain is against the grain. The result is a shovel many times stronger—in fact, almost non-breakable.

Note in the illustration of the new handle, the steel band compressed around the ends of the prongs and in the groove of the grip. The prongs are reinforced by the corrugated steel cap. They are carried up to the end full size, or practically one-half size of the stem. There are no rivets to weaken either the prongs or the grip. The compressed annealed steel band grips tighter and tighter, similar to being heated and shrunk on. It simply will not let go.

There is practically no metal around the grip to come in contact with the hand, thereby avoiding freezing and clinging to the hand in cold weather. There is also no checking or splitting of the grip, so that the hands are protected from pinching; and the grip is wider than standard handles, allowing more freedom for the hand.

A Mechanical Knife-Sharpener

IT'S a slow office, indeed, that is not now supplied with one or more of those very handy pencil sharpeners of the coffee-grinder pattern. The idea is so



Sharpening knives as we sharpen pencils

Stowing the curtains where they may be got out without disturbing the passengers

good, in fact, that some clever person has appropriated it for extension to the field of knife sharpening, as the annexed photograph indicates. For the milled grinders of the pencil sharpener are substituted miniature grindstones, set so that a knife may be held between them in a little rest, and operated upon on both faces simultaneously, by both wheels. A few turns of the wheel, with a judicious back-and-forth manipulation of the knife, and the trick is done. Perhaps the amateur grinder, with his complete uncertainty as to how best to bring the knife into contact with the sharpener, will be the greatest beneficiary of a system that attends to this detail for him, by means of the prearranged setting of rest and wheels; but even the professional will doubtless find that the machine works faster and better than his hands.

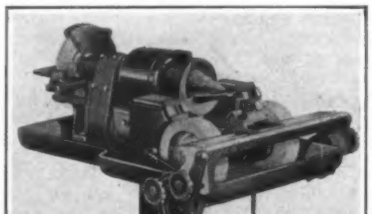
Pretty Figures by Machine

DESIGNOSCOPE is the name of the apparatus illustrated in this corner of the page, and the name is descriptive. The instrument is a modification of the kaleidoscope idea, with the difference that it does not contain its own bits of colored glass, etc. One scatters flower leaves, petals, etc., in its field, and on looking through the tube one finds that the several mirrors have done for these what the kaleidoscope does for its glass fragments—reflected them in several directions and made a symmetrical, conventionalized design of them. The designoscope, however, is not a toy; it is offered seriously to the designing profession, with the claim that with its aid attractive designs can be evolved out of bits of string, rags, flowers, leaves, tinsel—any old thing, in fact.

Kaleidoscopic instrument for manufacturing attractive and startling designs out of anything at all

A Place for the Curtains

DO the curtains on your car stow away in pockets overhead, which come open betimes and spill their contents upon your passengers? Or do they stow under the car seat, where they are got at only by disturbing the passengers, and where in the bargain the jack is likely to punch a hole through them when you hit a bump? Procedure for stowing them, heretofore, has been pretty largely confined to a choice between these alternatives, neither of which is wholly satisfactory. But now a third method is provided, in the so-called "curtain cache." From their storage point at the rear of the car the curtains can be got without disturbing anybody except the person who gets them; and they need not share the compartment with anything heavy enough to do them damage. They may, however, very conveniently share it, when the top is up, with the bag in which this is stowed when down, as well as with other light articles, to the owner's pleasure. The curtain cache is of English manufacture.



Grinding all the tools of the shop on a single machine

The Universal Grinder

SOMETHING decidedly clever in the way of an all-purpose outfit for the tool-room is shown in the adjoining illustration. On the one stand are mounted a coarse and a fine oilstone wheel, a grinding cone, a leather stropping wheel and an emery wheel. Each of these is accessible from two adjacent sides, obviating the necessity of walking all around the machine to get at the various wheels. Across the front of the oil wheels extends an adjustable slide-table, which may be tilted to any angle desired, and which carries a sliding tool-holder for holding chisels, plane bits, etc. The oilstone wheels are automatically kept saturated, the oil being driven out through the pores in the wheels by centrifugal force. Special devices prevent an over-accumulation of oil on the wheel face, and keep the oil from flying off. The machine is ball-bearing throughout. A better means of meeting the grinding and honing requirements of the shop would be hard to imagine.

Using the Stethoscope Idea for Locating Machinery Troubles

IN England a "neat little" device called "Spotanok" has been placed on the market by a company in Newcastle-on-Tyne, specially designed for motor-car owners. As its name suggests the purpose is the detecting and localizing of noises in machinery, but in many engineering works it will also be found useful. Practical engineers have been in the habit of making use of a strip of wood or a steel rule, one end of which is placed between the teeth and the other end is applied to the machine to find the source of noise and with good results; but in inaccessible places this method is difficult, if not impossible, to apply.

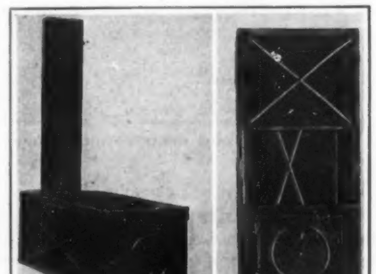
The Spotanok is a stethoscopic device which occupies a very small space and can be applied to parts otherwise inaccessible. It comprises a hollow metallic drum about the diameter of a half-dollar and one-half inch thick, one wall of which consists of a thin celluloid diaphragm. Hinged to the drum is a small trumpet-shaped receiver which, when placed against the machine under test, transmits any sound to the diaphragm with which it makes contact. To the opposite wall of the drum are attached two rubber tubes, fitted with ear pieces and about three feet long. After placing the latter in the ears the user applies the receiver to the suspected parts of the machine.

A London engineering paper says: "We have tested the appliance in several ways: On a four-cylinder petrol engine, which has been in use for several years; on the geared headstock of a lathe and on an air compressor cylinder, and in each case were able to detect noises which were quite inaudible to the unassisted ear. We found, for instance, in the case of the motor-car engine, which cylinder was the most noisy in operation, though we could not say exactly what the noise was due to. In the case of the geared headstock, we were able to detect a noise from the gears which suggested eccentricity in one of the wheels, and in the third case we were able to hear quite clearly the seating of the air valves, which was undetectable otherwise."

Other devices of this kind have been worked out and used in this country.

A Collapsible Stove

ONE of our contemporaries recently carried an article in which humorous reference was made to the tendency of the automobile camper to load down his machine with all the family Lares and Penates, including even the kitchen stove. Mr. Nelson B. Smith, of Spring Valley, Ill., takes some of the sting out of this particular jest by providing a stove which could be taken along without adding materially to the gross weight



Assembled and knocked-down views of the cook-stove that occupies no packing space to speak of

of the caravan. The size which he offers is 28 inches long, 12 high and 11 wide; and it collapses to a height of 1½ inches, its other two dimensions, of course, remaining the same, but the pipe being packed inside the box member so that it is included in the statement of knock-down dimensions. The pictures really tell the story, and leave little for us to say other than that, when the thing is assembled, it is easy enough to build a very effective fire in it, and use it to cook a very effective meal. It is decidedly refreshing to chronicle a stove invention that aims at something other than economy of fuel, necessary as that measure is.

A Microscope with a Single Lens

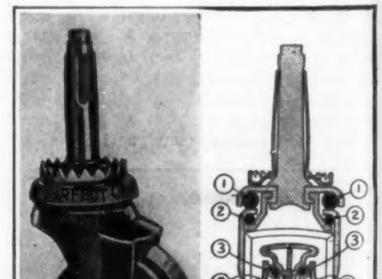
FUNDAMENTAL among the requirements of scientific work of any description is a serviceable microscope; and microscopes have always sold for a figure that makes their purchase a matter to be given the most careful consideration. An American manufacturer now offers an instrument complete, including objective, at a cost well inside the ten-dollar mark. According to the maker's statement, this is made possible by the development of a new technique for shaping glass lenses, which permits the manufacture of a single lens of sufficiently great curvature to give magnification of from 125 to 325 diameters. This is borne out by editorial examination of the apparatus, to the extent that it looks like the accompanying photograph and works as claimed; the single objective gives higher magnification than low-power compound microscopes of familiar types.

Microscope that comes within the reach of every pocket-book

It will be observed that while all the essential parts of the microscope are present, the tube is missing—in the absence of compound lenses it is not needed. The mirror, the stand and the objective are quite capable of the work of a microscope, just as they appear. The adjusting screw gives accurate settings to thousandths of an inch, and in every respect the instrument appears to be a real tool and not at all a toy.

For Dirigible Furniture

MOST of us have had experience with casters that will roll only in the direction in which they happen to be pointed, and which swivel into another direction only with difficulty. A ball-bearing caster as a solution of this problem is not exactly new, but the design which we illustrate is so. It is claimed to be quite unique in having the lower bearing in the head. It is this bearing which receives the lateral thrust and causes the caster to swivel instantly. In other stem casters, the swiveling action causes metal to rub against metal, and it is this which makes for slow swiveling or none at all. In each caster of the new model there are no less than 65 balls. These are all hardened and polished, while the yokes and wheel bearings are case-hardened.



External appearance and sectional view of the new ball-bearing caster

The little device for attachment to the radio set, which kills off the obnoxious howl

Killing the "Howl"

HOWLS and squeals on the radio will become obsolete, it is claimed, with great benefit to the broadcasting industry, if a new invention of C. C. Lauritsen and B. F. McNamee is generally adopted. The weird howls and siren-calls that afflict the radio fan's ear are almost invariably due to some neighbor, usually operating a single-circuit receiver, who is running up and down the wave-length scale to see what he can pick up out of the air, and in the process has temporarily transformed his set into a transmitter, broadcasting the wail of an unhappy puppy-dog for the benefit of an unappreciative audience who would much rather listen to WEAF or WHAT.

The radiation preventer is so small that it can be attached inside the cabinet or at the back, as happens to be most convenient. When properly connected, the inventors say, it will offer no obstacle whatever to incoming impulses, but will prevent any oscillations from the tubes flowing back into the aerial. All you have to do is to find the neighbor who is responsible for your troubles, and persuade him to install the device. He will find that he will not only be doing you a favor, but will increase the selectivity of his own set and the exactness of his tuning. Number one terminal is connected to the aerial, No. 2 to the ground, No. 3 to the aerial binding post on the set, and No. 4 to the ground binding post of the set.

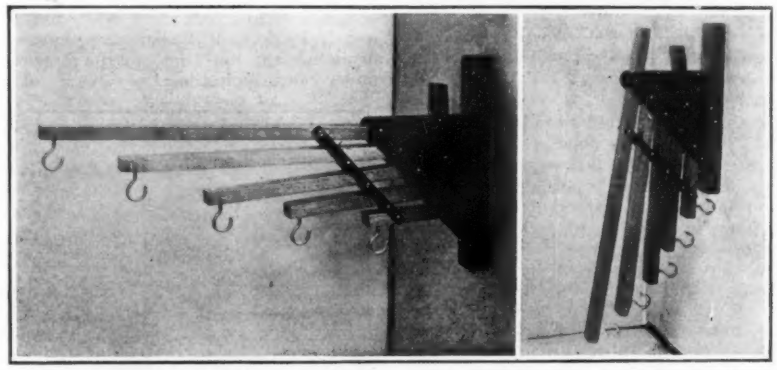
A Capsule Siphon

A SHORT time ago we illustrated a siphon charged from a "bottle" of liquefied carbonic-acid gas, and we now show another type still using the liquid gas but the container being a steel capsule or bulb. The siphon itself is netted with steel wire so that it is absolutely safe if the directions are followed; and if they are not, there can be no accident. This is a very valuable feature and removes it entirely from the class of the ordinary siphon which has been responsible for many serious accidents. The cold water is introduced into the siphon until it is filled up to the red line, the glass tube is then inserted and the head is screwed on after which one of the steel capsules or bulbs is placed in the holder which is then screwed into the siphon head slowly so that when the fixed pin in the head punctures the soft end of the capsule or bulb the gas will leave gradually and passing through the glass tube charge the water. While this operation is going on the siphon is shaken fully so as to assist in the proper charging of the water. The capsule and its holder remain in place until the siphon is empty. The pressure in the capsules is 1000 pounds to the square inch, but they are tested to 9000 pounds.


Charged water for the home from a fool-proof bottle

A Useful Indoor Tree

VARIOUS are the collapsible racks offered the housewife, for hanging towels and other impedimenta—we illustrated one, the other month, with a facetious remark about its resemblance to a synthetic Christmas tree. Here is another one, differentiated from most of its kind by the addition of hooks on the ends of its arms, and by the possibility of hanging it in either of two quite distinct positions, to fill either of two distinct offices. The vertical position particularly gives it aspects of utility in crowded corners which are not to be lightly disregarded.


Collapsible rack for kitchen use that is capable of adjustment to corners where the space is restricted

Light and Power for the Kitchen

MOST kitchens are lighted with a low-hung, bare lamp suspended from the center of the ceiling, and (owing to the greater intensity of the tungsten lamp as compared with the old carbon filament lamp) this produces a combination of glare and gloom—glare directly under the lamp and gloom on the walls; for the housewife's shadow is always on her work which is done mostly near a wall, at stove, sink or kitchen cabinet, with the light behind her.

To correct this faulty illumination lighting experts recommend that the light be mounted close to the ceiling and that the lamp be inclosed in a globe of translucent glass which serves to diffuse the light rays, producing an even and restful illumination.

But numerous kitchen-lighting campaigns have shown that the American housewife has some ideas of her own regarding the placing of her kitchen light. She admits that the enclosed light, mounted close to the ceiling is a vast improvement, so far as illumination is concerned, "but how am I going to get current for my electric iron, or toaster (she says), if I can't unscrew the lamp in my kitchen?"

Few of the eight million wired homes in this country have convenience outlets in the kitchen. The housewife uses the socket of her kitchen light as a current outlet and she is not willing to be deprived of it, even for the sake of a better light, but she would be very happy to have both.

This is what a Chicago concern has now given her in the combination illustrated. The light is mounted close to the ceiling and enclosed in diffusing glassware, as recommended by lighting experts, but hanging within easy reach is the plug-in switch to which she can attach the cord of her electric iron, toaster, or whatever electric appliance she wishes to use. A button projecting from the same plug enables her to switch the light on and off without interrupting the flow of current to her electric iron or other appliance.

Electrifying Dust Poison to Increase Its Efficiency

WHILE experimenting with airplanes in poisoning cotton boll weevils, Government experts in entomology and aeronautics found that with less dust a much better job of poisoning could be done with an airplane than with dusting machines operated on the ground.

Seeking for the reason back of this it was discovered that less dust could be used because the agitation of the air by the airplane propeller broke up the calcium arsenate into finer particles than a ground operated machine could break it, thus making it possible to spread a given amount of poison over a greater area; but more important than this, it was discovered that the velocity with which the dust particles were hurled through the air resulted in giving them a positive charge of electricity. The cotton plants are negatively charged. Hence an attraction was set up between dust and cotton that gave a thorough poisoning of the weevil's food.

Experiments are now under way to accomplish the same thing with a ground-operated machine that the airplane does to calcium arsenate. Initial tests indicate that it requires more than the agitation of the air with a propeller to electrify the dust particles. Ground contact interfered with the electrifying processes. The atmosphere apparently creates an insulation that helps to produce the positive charge of electricity.

The problem at this time involves the developing of artificial insulation for a ground machine. B. R. Coad, who is in charge of the Government laboratory at Tallulah, La., reports excellent prospects toward overcoming this obstacle. For solving this problem and bringing the results into practical use in properly designed machines, also to continue the promising investigations of the possibilities of using the airplane for regional spraying, Mr. Coad recently asked Congress for a special appropriation.


Diffused light for the kitchen, without interfering with the connection for the electric iron

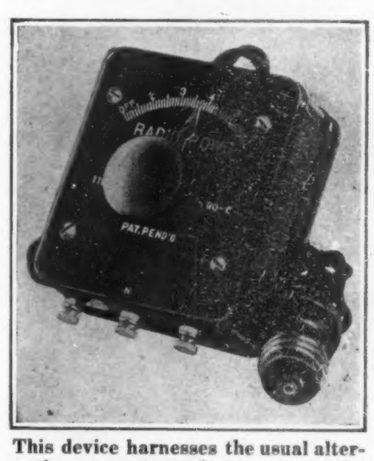
Pelton Wheel Built to Resist Sulfuric Acid

THE mountain torrent supplying power for the municipal hydroelectric station at Manizales, Mexico, is heavily impregnated with sulfuric acid. Indeed, it would be hardly an exaggeration to say that the plant runs on dilute sulfuric acid. Naturally no ordinary wheel would survive; but a Pelton wheel has been designed that permits the use of bronze, brass or monel metal at every point exposed to the water. This turbine is now being manufactured in Philadelphia and will unquestionably give satisfaction when installed under these extremely adverse conditions.

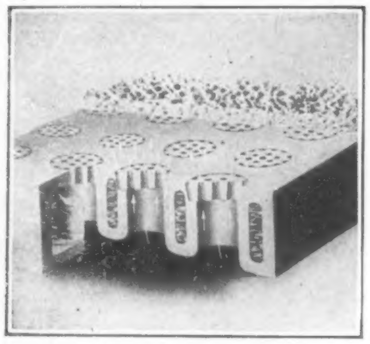
Doing Away with the Radio "A" Battery

THERE has recently appeared on the market a device which permits the application of alternating current to heat the filaments of radio-frequency and audio-frequency amplifying tubes, without the supposed and expected hum and distortion. This device does away with the use of the usual storage battery or dry battery, and therefore reduces the operating costs of the usual radio receiver.

The present device is not intended for the operation of the usual detector tube, but is limited to the amplifier tubes. This is largely due to the critical characteristics of the average detector tube. However, this device will operate the first detector of a super-heterodyne receiver or the detector tube of a super-regenerative receiver. This is because



This device harnesses the usual alternating current supply to vacuum tube filaments



Grate with water passages for controlling the distribution of draft

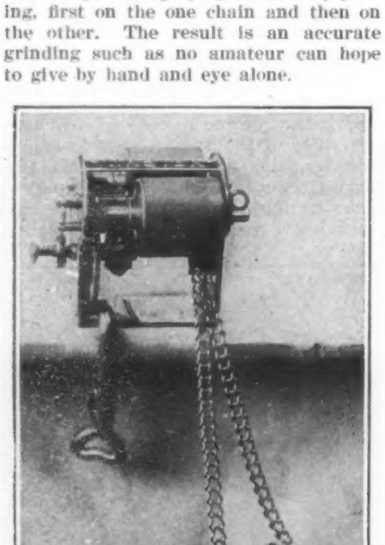
the detector in the super-heterodyne or super-regenerative set is in an oscillating condition and has less critical filament temperature characteristics. It has been found that on a single tube super-regenerative set like the autoplex, good results can be obtained with this form of filament current supply.

In the case of the usual run of circuits which employ a non-oscillating detector tube, the present device may be used for the amplifier tubes while the detector is represented by a battery-operated tube or by a crystal detector.

The new device is not intended for the plate circuit of the usual amplifier tubes, "B" batteries being retained for this purpose. It is made in several sizes for operating any number of tubes. The new device does not rectify alternating current to direct current, but on the contrary, alternating current, stepped down to the proper voltage, is applied to the filaments.

Saving Safety-Razor Blades

SAFETY-RAZOR users are of two types—those who consider that the ability to use the blade a few times and throw it away, without bothering further with it, is a distinct asset; and those whose economical souls are offended by this waste of the little metal wafers. For the latter person, there is now offered from Germany a little device which enables the user to sharpen his old blades for further use quite as efficiently as he could ever get them sharpened by paying good money to a professional. The blade is set in the space between the two rollers, and these are brought into play by alternately pulling, first on the one chain and then on the other. The result is an accurate grinding such as no amateur can hope to give by hand and eye alone.



German machine for salvaging safety-razor blades for re-use

A Water-Cooled Grate for Forced Draft

IF the smaller sizes of anthracite coal, such as rice and barley, are to be utilized a forced draft is necessary, for the voids between the grains of such small coal are too small to admit the 160 cubic feet of air necessary properly to burn a single pound of coal. One type of furnace made by a Philadelphia, Pa., manufacturer makes use of these small sizes of fuel (which are very much less expensive than the sizes commonly used in heating) in a unique manner. The ash-pit is sealed up and air is forced into it by means of an electric motor. This air is forced up through the grate through round cores and perforated

Getting the jelly-bag off the kitchen faucet

discs. The air outlets are placed at such angles that the air blasts from any two adjacent discs will meet at a point about two inches above the grate level. This is well below the center of any normal fire bed and the result is an even distribution of air, with no dead spots. All ash is removed in the form of clinker, the high heat produced by the projection of the air into the fire bed fusing the ash directly over the discs and then over the whole bed of the fire, and burning practically all the carbon from the coal. The grate, cooled by its circulating water, keeps this clinker soft and spongy. According to the manufacturer, it never "freezes" to the grate and is easily broken with a slice bar and removed with special tools through the fire-door.

Combination Gasoline Gage and Lock

WE have here a combination gage, lock and warning signal. When the handle is turned to the "on" position gasoline flows into the gage and through to the carbureter. By turning the handle to the lock position and turning the key the gasoline flow to the carbureter is stopped. If the car is running and stops because of a lack of gasoline the handle is turned to the reserve position and one gallon of gasoline is still left in the tank for use. In this manner the device acts as a warning signal that the gasoline supply needs replenishing.

The glass tubing is of exceptionally strong construction but if it should be broken the handle is turned to the reserve position so that no gasoline flows through the gage. The gage can be easily seen at all times as it is affixed against the partition separating the gasoline tank from the front of the driver's seat.

A Baby Car on a Walking Stick

THE illustration shows what is claimed to be the world's smallest baby car, which can be attached to any walking stick. The lower end of the stick is fixed to the axle of the carriage, while the back of the triangular chassis is clamped to the shaft of the stick. A comfortable canvas seat supports the child, a folding footrest is also provided; so that even a very young child can be wheeled along in perfect safety. The wheels are rubber tired, and eliminate shocks caused by bad roads. When not needed, the contrivance can be detached in a few seconds and folded up into a very small compass. Owing to its weight and compactness, the miniature baby car can be a constant companion on extended walks. As soon as the child gets too tired to walk, the car is unfolded and attached to the stick. The long leverage produced by the walking stick makes the propelling and steering of this baby car very easy and certain.

A Stand for the Drip-Bag

JELLY and pot-cheese, with perhaps some other things, are made by the housewife with the aid of a drip-bag, into which the mixture is placed and out of which the juice is permitted to drip. Usual kitchen procedure, in our own family and we presume in yours, is to hang the bag on the faucet, with a pan under it if the drip is the valuable part of the concoction and with the empty sink under it if the drip is to be thrown away and the dregs saved. This is neither the most convenient, the most pretty, or the most effective means of doing the trick; as is amply demonstrated by the jelly-bag stand which we illustrate. The stand folds up into a compass approaching zero when not in use, and affords a convenient means for being certain that the pan is properly under the dripping bag.

A convenient gasoline accessory for the flivver

Putting New Life in Submarine Cables by the Use of a New Alloy

COMPARED with the wonderful speed of the radio of today, the old cable for the transmission of messages seems cumbersome and crude. But recently there has been discovered a simple method by which "new wind," so to speak, has been bestowed on this old but almost indispensable means of communication, enabling it to compete more effectually with the wireless.

Not so long ago a new alloy was discovered which had certain unusual magnetic properties, but its special commercial application was not at first apparent. A mixture of about 80 per cent nickel and 20 per cent iron, it is a difficult alloy to make, requiring special temperatures and special electric furnaces. After it is successfully made, it is submitted to a special heating process or heat treatment which is one factor in conferring on it an extremely high

The world's smallest baby carriage

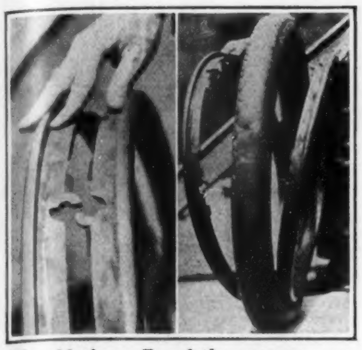
magnetic permeability at low magnetizing forces. It is far the easiest of all known metals to be magnetized or demagnetized. When properly heat-treated its initial permeability is more than 30 times that of soft iron.

The particular application which makes this alloy so valuable is its use in making submarine cables. It has recently been discovered that if this alloy, in the form of very thin sheets or strips, is made a part of the outer covering of such cables, it will be possible to permit messages to be transmitted at speeds many times those now attainable.

A Better Feed-Bag

EVERYBODY who has ever watched a horse struggling to get a meal out of the old-fashioned feed-bag must have made conscious observation of the fact that this device is about as ineffective an instrument as was ever devised by the mind of man. Poor Dobbin is strangled to death by the first part of his meal, and when he gets to the last part he flirts ten grains of oats out into the gutter for every grain that he captures for himself. The New York Women's League for Animals has offered rewards for humane devices applicable to the care of animals, and one of their prize winners is a nose-bag that avoids all these familiar disadvantages. The animal doesn't get smothered in his bag; and the oats feeds down a little at a time from the side pockets into the central compartment, so that a reasonable level is maintained under his nose.

A better meal for Dobbin, with less labor in the eating, than with the old type of nosebag



The old shoe off and the new one on in two minutes

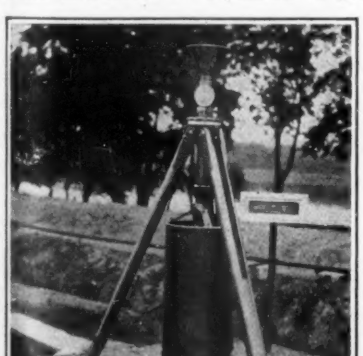
Quick-and-Easy Tire Changing

THE annexed photographs show the mode of operation with a new style of quick-change rim for the automobile. It will be seen that this rim comprises two solid ring sections provided with intermeshing lugs. The two sections are interlocked by means of three or more screw keys into one solid, integral rim which is claimed to have practically the full strength of the solid one-piece rim. With this rim the process of tire changing is completely reversed. Instead of mounting the shoe on the rim, the rim is mounted on the shoe. Jimmying the shoe over the flange of the rim by strong-arm methods is no longer necessary, for the two ring sections literally fall apart, off the shoe, the instant the screw keys are removed.

In operation, one ring section is laid down; the shoe is seated in place on this and the flap adjusted; then the other ring section is dropped into place and the screw keys inserted. Demounting is equally easy by reversal of this procedure; and a complete tire change can be made in two minutes, it is claimed, with no other tool than a screwdriver.

Testing the Underpinning of the Road

AN instrument for testing soils on which roads are to be built has been devised by the Bureau of Public Roads of the United States Department of Agriculture. It consists of a metal disk resting on the soil and supporting a cylinder into which shot can be poured. The apparatus is held in position vertically by means of a tripod, at the top of which is mounted a small dial that tells to one-thousandth of an inch how far the disk sinks into the soil as shot is poured into the cylinder. By means of the instrument it is possible to get



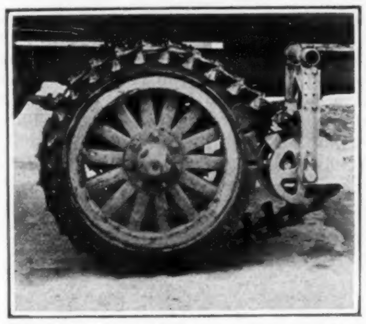
Finding how much road traffic a given subsoil will support

information as to how the soil will act in wet weather.

The kind of soil beneath a road surface has a great deal to do with how it will stand up under modern traffic and this is looked upon as an important consideration in determining the kind of road to be built. Two sections of the same road may be built in exactly the same manner and subjected to the same traffic but on different types of soil. One section may last well while the other becomes broken up in a manner that can only be explained by a lack of supporting power of the soil beneath the road.

Converting the Truck to a Tracklayer

THERE are dozens of times when a truckdriver would prefer to be driving a dirigible airship. Trucks, especially those having solid tires, get stuck in the mud quite easily and since they are usually very heavy, getting them out is sometimes an expensive job. Suppose



The truck that changes into a crawler to get out of tight places

you knew you could change your heavy, solid-tired truck into a tank-type tractor in 15 minutes and change it back again in 15 more—would you not feel more secure? When you see a big, solid-tired truck rolling along a street or a paved country highway there is no suggestion that it is about the easiest kind of a vehicle under the sun to mire up in a mudhole. As a matter of fact, it is worse than that—drivers of solid-tired trucks will refuse to enter on ground that is even wettish, for the small diameter wheels are in danger of dropping in. We illustrate on this page a way not to get stuck, so to speak. At the start let us say this is not meant for regular road running, but for crossing local patches of soft going, pulling out of fields, gravel pits and for general "navigation" around farms in wet weather. At the extreme left, out of the picture, is carried a reel, on which the truck track is kept when not in use, reeled up. The track is kept in tension in a novel manner. An intermediate idler mounted adjustably on a crankarm and running against the tire holds the track idler out in such a position that the track is always taut, thus giving it the greatest spread over the ground.

Practical Use for Paints Which Change Color at Different Temperatures

IN certain manufacturing and other processes where excessive heating must be avoided, attempts are being made to take advantage of the fact that certain special paint mixtures are known to change their color when in the presence of small increases in temperature.

Among these compositions is the double iodide of mercury and copper, which is normally red, but turns black at 87 degrees Centigrade, returning when cool to its original color. The double iodide of mercury and silver, which possesses a light yellow color becomes orange and red brick tinted at 45 degrees Centigrade, returning to the primitive color when cool.

The first of these mixtures is made by preparing two separate solutions of copper sulfate and potassium iodide in water. The second solution is added to the first, and agitated until the precipitate is dissolved; then it is treated with a mercury bichloride solution. The double iodide is precipitated, then washed and dried. Finally, it is mixed with a solution of gum Arabic and employed as paint.

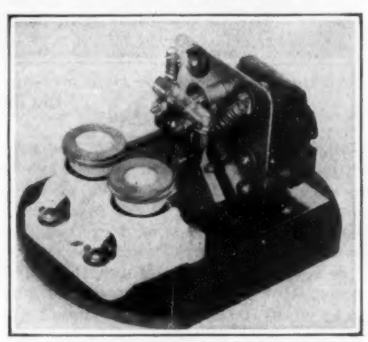
Experiments seem to show that an intense dry mixture of the two separate iodides is preferable to the above chemical preparation. Mixing is done in a ball mill with the constituents in the following proportion: Red Paint—mercury iodide 100 parts, copper iodide 40 parts. Yellow—mercury iodide 100 parts, silver iodide 400 to 500 parts.

Helium Progress

LATELY significant progress has been made in developing processes for the repurification of helium that would otherwise be wasted. At Lakehurst, N. J., a high-pressure, low-temperature apparatus has been perfected for this purpose. In its Cryogenic Laboratory the Bureau of Mines, cooperating with the War Department, has used activated carbon as the basis for a simple method that is said to yield striking results. The impure helium is passed through the usual type of charcoal adsorber. At low temperatures the carbon exhibits the remarkable property of adsorbing all of the 15 or 20 per cent of nitrogen and oxygen that contaminate the gas. The helium continues to pass from the adsorber in 100 per cent purity until the saturation point is reached for the carbon, which is then easily regenerated.

The Perpetual-Motion Mercury Switch

TALK about tireless! The drop of mercury in the little glass tube of this mercury switch, which is used to flash on and off the lights in the new General Electric street traffic signals,



A contact every second, to operate flashing traffic signals

travels from end to end of the tube once a second, which means 31,536,000 times during a year of continuous operation. In doing so, it covers a distance of approximately a thousand miles, although the length of the tube is only about two inches.

The tube is rocked by a little clock motor through gears which run in oil and oscillate the tube once a second. The mercury rushes down to one end, makes a contact which flashes the light on for a second, then hurries back and repeats the operation at the other. After the mercury has been placed in the tube, the air is exhausted and replaced with hydrogen, which prevents any possible formation of mercury vapor by the spark. There are no metal contacts to wear out or burn off, and barring defects in the glass the tube is practically everlasting, while motors of the kind used have been run continuously without a breakdown for two and a half years. This motor, by the way, consumes only four watts in operation.

The chemical bag that delivers heat on addition of cold water

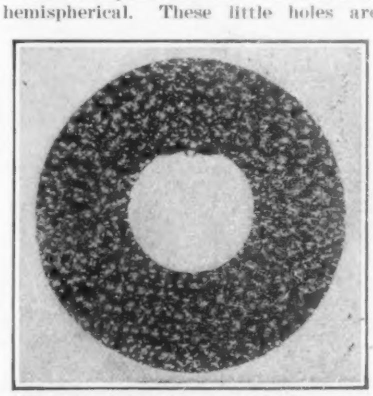
Heat from a Cold-Water Bag

THREE teaspoonfuls of cold water placed into the novel heating-bag shown here, will react with chemicals contained in the bag and give 24 hours' constant heat. The chemicals are contained in compressed form in the inner refill element; each refill is capable of generating a hundred hours' heat. Should the heat only be needed for a short period, then the heating element is taken out of the bag and laid on a cold surface, such as a marble slab or the windowsill, when it will quickly dry and cool off.

The dimensions of the outer cover are ten by eight inches; the complete bag weighs about a pound and a half. Not only as a bed warmer, but also as a great comfort to travelers in cold weather, this novel invention should prove invaluable. Tests conducted at a leading London hospital confirmed the claims made for this new heater, and in consequence, a large number of them were adopted as part of the standard equipment.

The Granulated Pipe Joint

FLANGED pipe joints sometimes leak. Some people who have had unpleasant experiences with them would say, perhaps in some measure unjustly, that sooner or later they always leak. The cement that is used with them refuses to stay put. If the joint is set up tight, that very act tends to squeeze the cement out; or in other words, a high pressure cannot be put on it without squeezing the cement out. But a Pittsburgh manufacturer has brought out an improvement which it is stated can be broken time after time without loss of its usefulness. The surface of this fitting is granulated. It is pockmarked with hundreds of depressions each of which is hemispherical. These little holes are



The pipe-joint that won't leak, even after being taken apart and put together again

Treating old ties with press and S-irons to render them again serviceable

just about as close together as they can be placed. This means that their walls often or usually thin off to nothing. These thin edges make it possible to make the metal of the flange conform to the opposite fitting, the thin metal crushing down slightly for this accommodation. Between these edges the cement is held where it cannot escape. Tests have shown that these joints are as efficacious for gas as for fluids.

The Decoding Typewriter

HIGH-SPEED coding and decoding of cable messages is accomplished by means of the assembly of two typewriters, electrically connected. As the operator runs off the original message on the one, the other types out the code version. When used at the receiving end, the order of things is reversed, and the coded message as taken off the wire is fed into the one machine, while the other merrily types the decoded message. The two machines, of course, have their keyboards electrically tied together, according to just what code is being used. If it is desired to keep this code secret from the operator, the second machine may be in another room. The apparatus is being exhibited at the Institute of Patentees, in London.

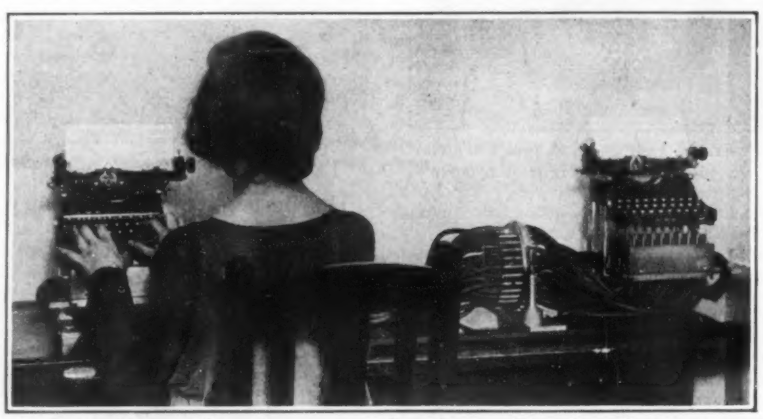
A New Jazz-Producer

AMONG recent musical novelties is a new instrument for the production of unusual jazz effects. As the photograph indicates, it consists of a steel band, against which two hammers play. The blows cause vibrations that are true in tone, the degree to which the steel band is flexed varying the pitch within surprisingly wide limits. The operator's thumb is used to produce this flexing; and the reader who has seen the vaudeville stunt of playing tunes on a saw, which is bent through various arcs to get the various notes, will realize the practicability of the new instrument. The "flex-a-tone," however, being specially constructed for the purpose, has a much wider range than the saw; and its operation is extremely simple. Its tone is described as a clear, flute-like singing whistle, with tremolo effect.

Putting the musical-saw idea to commercial application

Reclaiming Checked Railroad Ties

A FEW years ago crossties were so inexpensive that little pains was taken to save them. Wastefulness was in the air. Today, ties cost dollars where they once cost dimes. Mr. Andrew Gibson, superintendent of the timber-preserving and tie-treating plant of the Northern Pacific Railway, at Brainerd, Minn., has devised a very effective method of saving ties which have split during seasoning. Checked ties of this sort are pinched at the ends by means of a lever and chain, both of which, together with the brawny motive power, are clearly shown in our illustration. While the opening is reduced to a crack, two or three "S-irons" are driven into the end grain of the wood, holding the split ends together for the life of the tie. The "S-irons" are made of strap iron forged to an edge at one side so that they may be driven into the grain of the wood sidewise. If little economies such as this could be applied to our whole railway system the cost of the freighted goods everyone buys would be lower. It is very difficult to enforce the spirit of economy in a large factory of any kind; while if the factory is spread out over hundreds of miles, as is the case with a railway, it is still harder. The difficulty is to make men see that the big, rich company has correspondingly large expenses, and that the need of little economies is as great as it is in the case of the individual.



As the typist runs the code message off on her machine, the other one taps off the decoded version

The Last Word in Motion-Picture Screens—the Multi-Power Projection Screen

EVERYONE interested in moving picture projection is familiar with the advance made in the design of screens—the cloth sheet, the white kalsomined surface and the metallic semi-reflecting screen, all employing the principle of diffuse reflection, the last-mentioned surface being about three times as bright with a given projection illuminant as the white matt surfaces.

The latest contribution to the art is the multi-power total reflection screen employing a highly polished structure the brilliancy of which may be as high as desired, since the picture light is *specularly* and not diffusely reflected.

This high brilliancy is obtained on the multi-power screen by concentrating and confining the light reflected from the screen itself through a limited solid angle embracing the area occupied by the audience, the surface being made up of anywhere from 25 to over 1000 of identical juxtaposed curved reflecting elements which are rolled into a highly polished metal sheet. The tiny elements or reflectors are of precise mathematical curvature and equally inclined to the general surface and small enough to present a continuity of view, the effect of the whole being analagous to that of a searchlight, which gives a directional beam of predeterminable divergence and intensity. On the latest surface the elements are ellipsoidal and about one mm. apart, the screen appearing smooth at a distance of ten feet.

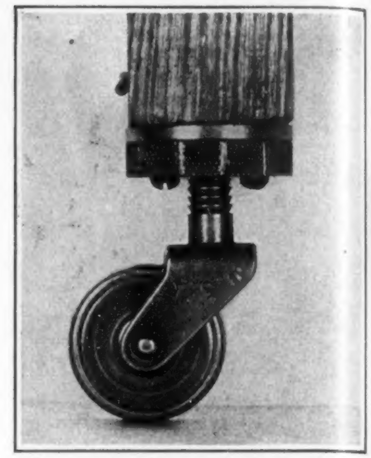
Sounding by Acoustical Methods

DR. HARVEY C. HAYES, one of the research physicists of the U. S. Navy, gives an account in the *Journal* of the Franklin Institute for March, of the methods which have been developed recently for sounding the harbors and rivers of the United States by means of the echo from the bottom. The first method determines the delay of arrival at a point in the bow of a vessel and at a point between the bow and stern, of the sound of the propeller reflected from the bottom. The second determines two consecutive frequencies of a sound transmitter at which the sound reflected from the bottom returns in phase with the sound emitted. The third determines the interval between two short signals such that the echo of the first arrives at the sender at the instant that the second is emitted. Depth curves obtained by these methods during the voyages of several of the ships of the United States Navy are given and they agree closely with direct soundings.

The Adjustable Caster

CASTERS of the conventional models have numerous faults. Sometimes they are rigidly fixed in their sockets, so that they are unable to compensate for a short leg or an uneven spot on the floor, and the table or chair can be kept on an even keel only by putting something under one leg. On fixed furniture, perhaps, this has no other disadvantage than unsightliness; but on rolling furniture it means that the block must be moved and replaced every time the table is moved. Then, too, who has not had a caster that took too solid hold of the carpet, so that pressure on the sideboard, instead of moving that article, merely crumpled the carpet into a huge fold. And finally, every housewife knows how easily the plain, unadorned caster of a by-gone day drops out of its socket when she attempts to move the furniture about.

The caster which we illustrate avoids all this. The plate screws on easily to the bottom of chair-leg or table-leg, and then by an eighth turn it locks fast in place, after the shank of the caster has been screwed in or out until a perfect adjustment is obtained. And then you have a caster that will work smoothly under all conditions.

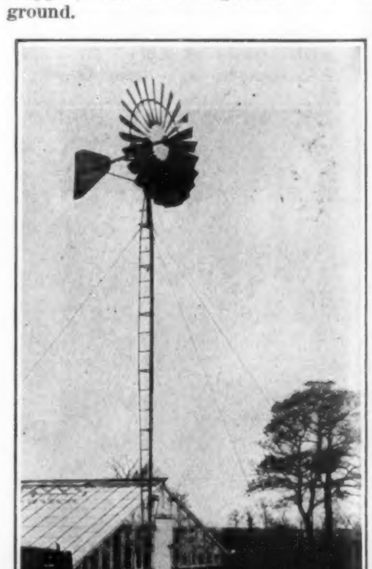


The caster that adjusts itself to every condition of service

Wind-Power for Country Houses

A NEW type of windmill enables residents in the country to obtain electric light and power at practically no cost for upkeep and maintenance. The wheel is supported by a single spar, which is pivoted at the lower end. Erection is very easy, and also repairs, etc., as the whole structure and wheel can be swung down to the ground. The construction of the wheel is novel; a wire-wheel similar to a cycle wheel forms the backbone, to which curved steel blades are attached.

The dynamo is housed in a weather-proof casing and mounted close to the wheel, a chain drive effecting the connection. The entire top is pivoted on a vertical spindle and swings around as the wind alters its direction. The supporting spar is a light lattice girder and held by three stays. The bracing pieces of the spar form a ladder, by means of which the top can be reached for inspection, etc. The bottom bolt, to which the mast foot is pivoted, is anchored in a small concrete block. By means of a special hand-control, the wheel can be stopped, started or regulated from the ground.



Bringing the wind-mill into service for electrifying the farm

The Transatlantic Voyage of "ZR-III"

How She Will Evade the Tornadoes and Storms of the Western Ocean

IF THE hopes of her builders are realized, "ZR-III," the new Zeppelin recently completed in Germany for the United States, will sail for this country late in July or in the early part of August. Although the ship itself was completed some months go, there has been delay in bringing her motors up to e point of reliability necessary to justify her setting ut on a transoceanic voyage of at least 3400 miles. his would be the length of the trip, if her course could e laid out on a great circle; but, if, as is quite possible, e should encounter one or more storms, her course ould be changed to avoid hem and would be correspondingly lengthened. This ill be made clear by these wo maps, drawn from ketches furnished us by one f the German officers who ill bring the big ship over.

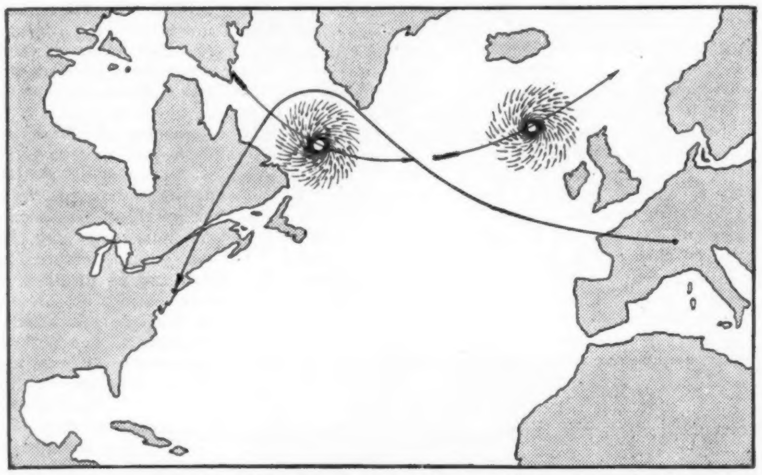
The "ZR-III" was built at riedrichshafen, at the great lant which is associated with e name of Zeppelin. She as allocated to the United tates by the Reparations ommission of the Allies, with e stipulation that she was be used only for commercial nd scientific purposes. She the largest and fastest airhip ever built and possesses e widest radius of action. oreover, the Germans have ut into her all the experince which they gained in airhip construction during and fter the war. In her hull esign particular attention as paid to the longitudinal strength, with a view to reventing that buckling of the longitudinal members hich proved fatal to "R-38" in the Hull disaster. It ay be said that, considered as a framed structure, ZR-III" is more rugged than any of her predecessors. he bow has been designed to resist such a sudden side rust as tore loose the nose-cap of "Shenandoah"; and e fin structures astern have been built with a wider ase and of stiffer construction than is found in earlier hips.

The dimensions are: length, 656 feet; diameter, 90 et; and capacity, 2,472,000 cubic feet. The motive ower consists of five 400-horsepower, 12-cylinder moors, which will give her a cruising speed of 65 miles er hour and a maximum speed with full power of 8 miles per hour. Her endurance, at 65 miles per our, is 5200 miles, so that, unless most exceptional, if ot impossible conditions prevail, she should make the ip from Friedrichshafen to Lakehurst, with a satisctory margin of fuel reserve.

The delay in the start has been due as we said to er motors. They are of the famous Maybach type, hich in its six-cylinder form, as used during the war, roved to be one of the best, if not the finest airplane otor of them all; its excellence consisting in its rearkable reliability and fuel economy. But for ZR-III" the makers decided to build a new 12-cylinder, -type motor, and it was while bringing this motor up the high level of the well-tried, six-cylinder type that e ship was held back.

The navigation of "ZR-III" will not be a simple atter of flying a straight course across the Atlantic, lthough, if weather conditions are exceptionally favorble for three or four days, this may be possible. In ase she should encounter storms her course will be laid as to pass around and preferably to the north of hem. But why to the north? Because the winds in North Atlantic storm rotate counter-clockwise around center which itself may be traveling from 30 to 50 iles an hour in an easterly direction. Consequently, airship that attempted to pass to the south of a orm might be caught in the outer belts of wind, which ould be traveling at high velocity against the ship; hereas, if, in passing to the north, she came within e circumference of the storm, the winds would be ith her and consequently would very materially help e ship upon her way.

There are two general types of cyclones, known as e tropical and extratropical. The latter are far more umerous, and are encountered in middle and northern latitudes. Tropical cyclones, in which the winds are fiercer and more destructive, are relatively of rare occurrence. The extratropical cyclones, which are those the "ZR-III" will be more likely to meet, may have a diameter as great as 1500 to 2000 miles, although the average size is believed by our Hydrographic Office to be between 500 and 1000 miles. According to this authority, the storms move, almost without exception, in an easterly direction, though at times their course may have in it a north or south component. The tropical cyclones, which usually originate in the West Indies, are smaller but at times of an indescribable fury. Their average diameter is about 300 miles. By reference to the two accompanying sketch charts it will be seen that, while the center of these cyclonic disturbances moves over broad, curved courses, the winds themselves have a rotary movement about these centers.



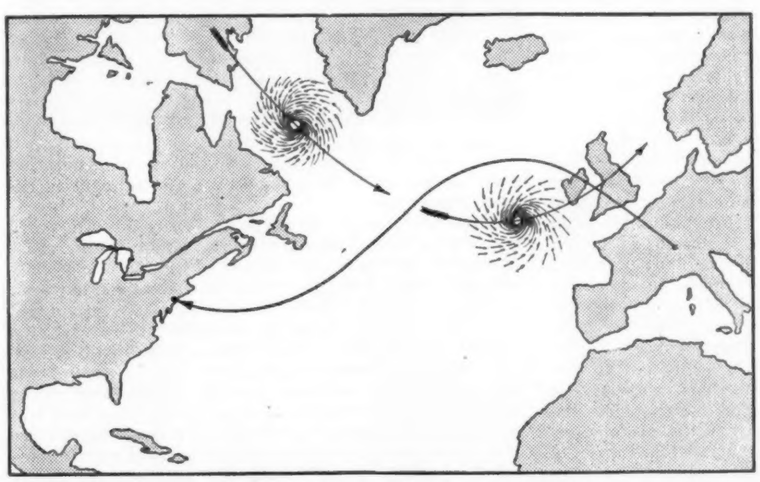
The course of the "ZR-III" across the Atlantic will be determined by the position and movement of storms that may be encountered

A part of the training of Zeppelin pilots for some years has consisted in making so-called "synthetic" flights across the Atlantic. These were instituted by Count Zeppelin, who had planned to engage in commercial flying between the two continents. In following up this plan, the log books of steamer captains and all available weather reports for the last 25 years were collected and charted; so that a pilot in training could be assigned to make a theoretical transatlantic trip, as of any given date in the past, and would have before him the actual weather conditions obtaining along the route at that time. More than a thousand of these imaginary flights have been made by Zeppelin pilots, and this is now part of the training of the men at Friedrichshafen who will bring the ship across.

In one of our sketch charts, the ship, at the start of her voyage, learns that a disturbance is approaching the west coast of Ireland and will shortly be swinging in a northeasterly direction. The pilot, therefore, decides on a northwesterly course, so as to carry him to the north of the storm and (should he run into it) within its outer and favorable easterly belt of winds. Later, he learns that another disturbance is swinging down in a southeasterly direction from the Labrador coast, and accordingly he turns and maintains a course well to the south of it until he reaches Lakehurst.

On the other chart are shown two storms, one traveling northeast off the northwestern coast of the British Isles. In this case he lays a straight course for Lakehurst until he is warned of a cyclonic disturbance which is traveling off the northeastern coast of the United States, and accordingly he swings north to get into its favorable northerly quadrants. It should be noted that because of the excellence of the radio reports sent out by the various weather bureaus, the pilot, on starting, is in possession of a general knowledge of weather conditions. Once clear of the coast, he is more dependent on his own resources and he has to battle with the storms as they come; although, even aboard ship, it is possible to make reliable predictions covering 24 hours in advance.

Cyclonic storms, however, are not the only meteorological problems that must be met and solved by a transatlantic airship pilot. There is the thunderstorm with its fierce and sudden gusts and appalling lightning strokes. It will surprise many of our readers to learn that the Zeppelin pilots profess not to fear destruction of their ships by lightning, and they will tell you that they have passed through electric storms of the greatest intensity, when the ship was struck but suffered no damage.



This chart shows a storm off the British Isles. "ZR-III" lays a course to pass north of the storm, where the winds (revolving counter-clock wise) will be westerly and therefore favorable

Forests and Rainfall

THE question of the influence of woodland upon rainfall is a very old one, yet it cannot be said even now to be fully answered. While there is indisputable evidence from all parts of the globe that the reckless destruction of forest-growth has brought progressive desiccation in its train, it has only comparatively recently come to be realized that the problem is essentially hydrological rather than meteorological. When, indeed, one reflects that a forest is itself primarily an adaptation to rainfall and other climatic conditions, it is somewhat surprising that the earlier investigators should have expected to find anything more than a secondary reaction of the forest upon rainfall. No doubt the characteristic type of forest prevailing in moist regions helps by maintaining the humidity of the atmosphere to equalize, if not slightly to increase, the rainfall over the year as compared with denuded tracts; but, on the other hand, recent research has shown that where forest and scrub are composed of drought-resisting species, reducing transpiration to a minimum, a distinct increase of rainfall has followed deforestation.

It is, however, as a hydrological agent that forests play an immensely important part in conserving moisture in the soil, regulating its discharge into rivers, and in general modifying the natural drainage of a country. It is satisfactory to find that this deeper understanding of what is in reality a very complex problem in physical geography is leading to investigations, for example, in Italy, on the relation between rainfall and woodlands in all its aspects.

It has been shown, however, by an eminent climatologist, von Hann, that forests do very decidedly increase "rainfall" in the broader sense by collecting the moisture of fog. This is especially true of hill-fog and mountain-mist. Upland fog is, by its different mode of origin, normally wetter than lowland fog, and on drifting across wooded mountain slopes deposits large quantities of moisture. Indeed, even in the drier lowland fogs produced by radiation on cold nights, there is a constant dripping of water beneath trees.

A Neglected Well of Information

The Unrealized Possibilities of the United States Patent Office Files

By Karl Fenning, Assistant Commissioner of Patents

THE United States Patent Office was established in 1836. The first United States patent was issued in 1790 in pursuance of laws passed to carry out the section of the Constitution which contemplated the encouragement of the arts and sciences by securing to inventors exclusive rights in their inventions. They are authorized monopolies. Most people are aware of the fact that when something new is produced or when a bright idea is developed the Patent Office should be approached for the sake of obtaining protection. The ordinary attitude toward the Patent Office is that of the selfish individual who feels that he is procuring for himself exclusive rights with respect to his own individual device or invention. From the beginning, however, the Government has taken a somewhat broader view of the matter. To be sure protection is given to an inventor, but it is given to him only on consideration that he make a sufficient written disclosure of his invention to accompany his patent. This disclosure is examined very carefully in the Patent Office to see that it does give a clear understanding of the new thing. The purpose of this disclosure is to insure that the general public shall know how to use the invention after the termination of the seventeen-year period of exclusive use given to the inventor. To this end, the patent is printed and published by the Patent Office. A weekly *Official Gazette* including all patents is also published. This may be subscribed for at $5 per year.

Actual manufacture of the invention may make it familiar to the public. A very large number of patents, however, are based on inventions which are never worked. For one reason or another the inventor never gets to manufacturing and selling his device. It may be that capital is not available for its promotion; it may be that the invention is ahead of its time; or it may be that before actual commercial operations are instituted the attention of the inventor is diverted to some other line of endeavor. There is, then, in the United States Patent Office a very large store of extremely valuable knowledge which is available to the public, but which is not always availed of.

As suggested above, when something has been produced, frequently the producer carries his new thing to the Patent Office in the hope of obtaining protection. The professional inventor or designer, as well as the ordinary business man, however, might very well avail himself of the Patent Office at an earlier stage. The Patent Office records are open to any member of the public. There are about a million and a half United States patents already issued. In order to make these usefully available, they have been carefully classified by the Patent Office into about three hundred main classes, in which there are several thousand subclasses. It is, therefore, generally possible to find assembled most of the patents relating to any field of endeavor. All patents are printed and copies may be obtained at ten cents each. The Patent Office has a list of classes with definitions, all of which is changed from time to time as the arts progress. The classification is constantly changing to meet new conditions. One who is about to enter into manufacturing of a new device or a new line, even before proceeding with the preliminary design and development work, might well procure and investigate the patents in the particular subclass in which he is interested. Much time and energy devoted to research and experiment may be thus avoided by using the experience of others who have already gone over the field.

Such an investigation is valuable from several standpoints. First of all, it will show what is disclosed by patents which have expired. All this matter is open and free to any member of the public to be used. Such a search will also show what is still covered by live patents and so indicate the things which should be avoided as not open to the public. It is frequently possible to obtain some such patent, which is not being worked, for a nominal sum and thus procure a ready-made entrance into the industry. An examination of the patents in a class will also generally reveal a number of different ways of approaching a problem. Frequently, much experimental work may be avoided by seeing what has been attempted by others and by comparing it with the things which are actually in the market. Few people would shut their eyes to active competition in the market to the extent of not investigating and not knowing what other manufacturers are producing and selling. It is equally important to know what others have devised or tried and not succeeded with, and frequently the only source of this information is in the Patent Office.

In addition to United States patents and a valuable collection of American and foreign textbooks and technical journals, the technical library of the Patent Office has patents of the principal foreign countries of the world and an investigation there is possible to indicate what is being done by foreigners. This is the only place in the United States where copies of all published foreign patents can be found. This is especially useful and important when it is proposed to enter the export field and compete with foreigners, but it is also of useful interest as it gives the result of the development and ingenuity of not merely our own citizens, but also the most active minds of the world elsewhere.

This great storehouse of information is used frequently to reveal the prior art so that a patent may not be held to cover more than it should, but it also has great possibilities of a positive character to give one the state of the art as a foundation for further building.

OUR Patent Office is regarded by most of us as simply the agency through which patents are issued. This of course is its primary function, but it possesses possibilities of further utility which have never been developed. In the archives of the Patent Office lie something like a million and a half American patents, and in the Patent Office library are available many thousands of foreign patents. The history of every art is here, complete for the period covered. Mr. Fenning makes a remarkably good case in behalf of his contention that this body of information is of potential value far beyond anything that has ever been got out of it.—THE EDITOR.

The receipts of the Patent Office have exceeded its expenditures. The collection and publication of this valuable information has cost the Government nothing in dollars and cents. In spite of the small amount of money available, it has been possible to do much. Possibly if the appropriations were expanded—even to exceed the fees taken in—it would be possible to review, digest and disseminate more thoroughly and more widely the subject matter covered by the patents.

An invention discarded or rejected by one generation may become the corner-stone of a great industry in the next generation.

A patent lasts for 17 years and the matter included in it is, of course, avoided by the public during those 17 years. At the expiry of the patent, it is generally dropped from mind. If the Government, however, would provide the proper funds, the Patent Office might issue an annual volume in accurate language setting out the development of knowledge as shown by the expired patents. Such a publication might then indicate what enrichment had been made to the free field during the past year by expired patents. Some such idea was at one time in the mind of Congress because it provided that the annual reports of the Commissioner of Patents should include a list of patents expired during the previous year but the list was published in a form which was not particularly useful and was consequently discontinued.

In these days when the other departments of the Government are going abroad for research and investigation, it is somewhat surprising to find that no effort has been made to provide the Patent Office with funds to collect and publish information in the various arts with respect to foreign patents. A foreigner may procure a patent in the United States on the same matter covered in his foreign patent, but his application in this country must be controlled by a definite time relation to his application or his patent abroad. One technically informed with respect to the patent laws may examine the patents issued in Germany, for instance, or England, in the year 1921 and gain from them much information as to matter not covered by United States patents—and so free to the use of our public. If the information were assembled in an annual volume arranged and classified according to subject matter manufacturers and investors would have at their hands a ready means of ascertaining what had been published to the world and was free of monopoly control in the United States.

Publication of this information which is after all intended to benefit the public will probably be accomplished only when the Government is willing to do as much for the artisan and mechanic and the manufacturer as it now does for the farmer who raises wheat or pigs. When that day comes, there may arise from the Patent Office, which to many is a graveyard of dead hopes, revivified beings to aid and soothe humanity.

Antarctic Sea-Ice

THE study of the Antarctic ice-pack may be approached from two distinct points of view. In the first place, we may consider its movements on a large scale, its distribution and direction of drift, its formation and its ultimate disappearance, and the geographical bearing of these matters. For it is the presence of the ice-pack which has limited the exploration of Antarctica, and no future attempts to reach the still unknown coasts are likely to succeed unless the known facts concerning the distribution of ice are taken into account. In the second place, we may consider the physical aspects of the pack ice, its growth, the changes of structure it undergoes after its formation, and the causes producing the breaking and motion of the ice fields.

One important point which has been learned from the drift of ships which have been beset and carried with the ice is that there is a considerable westerly component in its motion. The chief motive power of the drift is undoubtedly the wind flowing down from the continental ice-sheet, which is generally south-easterly in direction and so accounts for some of the westerly component. In addition there is a well marked tendency for the ice to move to the left of the wind direction owing to the rotation of the earth. The actual direction of the ice-drift at any place is to a large extent governed by local circumstances, such as the presence of promontories or ice tongues. But for the navigator it is very important to keep in mind the general westerly tendency.

In considering the structure of the pack, it should be remembered that the growth of the winter's ice usually starts in a sea already covered with loosely packed fragments of old ice which the new ice cements together.

The large winter floes are quite heterogeneous in character and are liable to break up owing to a variety of causes. The ice sheet grows by breaking, opening and thus forming pools, over which a new ice surface soon forms. The new ice may, however, be crumpled up again to form a pressure-ridge. Some very interesting physical problems are associated with the cracking and relative movements of large ice floes and the subsequent formation of pressure ridges.

Another point that is clearly stated concerns the mechanism whereby, after exposure to summer temperatures, the hummocked ice loses its salt completely while even ice *in situ* loses it to some extent. The salt is imprisoned between the flakes of ice during freezing and newly frozen ice has a platy structure, giving a section of it a fibrous appearance, while ice which has lost its salt has an entirely different structure, and appears granular and bubbly.

Undoubtedly, according to our authority, high temperatures are necessary for loss of salt to take place but it cannot be a mere draining out of a saline solution under gravity, since the ice is not porous and an ice sheet in place is subjected to a hydrostatic pressure which should tend to force the salt water into it. It is probably that an alternate freezing and thawing of the saline inclusions in the ice such as takes place periodically, will cause them to pass slowly downward through it.—Abstract from article by R. W. James in *Nature*, March 29, 1924.

Our Radio Page

Listening-In on the Latest Progress of the Radio Broadcasting Art

The Art of Tuning the Radio Receiving Set

TUNING the receiver—a rather late day to be telling several million listeners-in how to handle their set! True, but there are ample indications that everyone does not yet know how to tune a receiving set and, what is more, is quite unaware of the fact. The bedlam of noises that occasionally mar our radio programs are due to faulty tuning. Indeed, the greatest technical problem of radio broadcasting is the elimination of the squawks, groans, shrieks, whistles and "birdies" in general, which interfere with what would otherwise be flawless reception.

The cause of these unbecoming noises is radiation. By that term the radio engineer means the transmission of radio energy by a receiving set. In the usual vacuum tube receiver, especially of the well-known regenerative type, if the tuning is carried beyond a certain point the tube no longer acts solely as a receiving tube, but begins to function as an oscillator or generator of radio waves. In this oscillating condition the receiving set now becomes a miniature transmitter, and sends out a weak radio wave that may be detected over a distance of a quarter to half a mile. This weak wave, or radiation from the receiving set, is picked up by surrounding sets tuned more or less to that same wave length. Just so long as that weak wave is by itself, it produces no noticeable effect in the surrounding receiving sets; but as soon as another wave of practically the same wave length is received, the two waves interfere with one another and produce an audible sound or "beat note" in the telephone receivers or loud-speaker of the radio receiving sets.

No matter how elaborate may be a receiving set, it is subject to the "birdies" of nearby receiving sets in the hands of careless operators, just as the motorist on the public highway is liable to damage and injury from a careless driver. In fact, there is a striking parallel between the radio broadcasting situation and the highway courtesies: just as motorists have learned to drive carefully, dim their lights and, in general, watch out for the other fellow's welfare, so radio enthusiasts are learning that it pays to keep one's set from oscillating and interfering with the radio enjoyment of others, because by so doing the radio atmosphere must eventually be made ideal for everyone. Radio engineers and manufacturers are also working to this end by designing and manufacturing radio receivers that will not radiate, no matter how they may be handled.

The receiving set most likely to radiate when improperly tuned is the simple but highly efficient single-circuit regenerative type. There are two controls in a set of this type, one being known as the tuning or "station selector" knob, and the other as a tickler or "intensifier" knob. The tuner knob makes it possible to tune in one station and eliminate the others, while the tickler or "intensity" knob serves to increase the signal strength. *Both controls should be operated simultaneously.*

The single-circuit regenerative receiver is, unfortunately, in rather bad repute today because of its radiation possibilities. Yet here is a circuit which will reach out farther and give louder signal response than many of the more elaborate and more costly circuits now in use. When properly tuned, it will not radiate. The first step in its proper manipulation is to set the tickler at zero, and then bring the tuner control to approximately the setting where one expects to find the desired signal, and, with the other hand, the tickler control is brought up to the point where a slight hiss or rustle is heard. The tickler is maintained at the hissing point while the tuning control or "station selector" knob is manipulated to tune in the desired station. If the signals are not quite clear, the tickler is moved back just a trifle so as to clear up the slight hiss. The tickler should never be increased beyond the hissing point. If it is, a whistle or squeal will be heard in the telephone receivers or loud-speaker, indicating that the set is now oscillating or sending out an interfering wave. If a slight change of the tuner adjustment results in a whistle or squeal, it is an indication that the set is oscillating and radiating, even though it may be otherwise silent. This may be remedied by decreasing the regeneration or tickler adjustment, until the whistle or squeal disappears.

Then there is the regenerative receiver with three controls, one being for the station-selecting work, another for tuning the secondary or tube circuit, and the remaining one for regeneration. This type is known as the three-circuit regenerative receiver and is highly selective, although it requires considerable skill and patience to get the maximum results of which it is capable. Since this receiver has three controls, the general tendency is to set the tickler or regenerative control to maximum, and then tune the primary and the secondary until the whistle-like note of a broadcasting station is heard. All this while the receiver is sending out an interfering wave, which is playing havoc with nearby radio receiving sets to the disgust and indignation of neighbors.

The way to operate the three controls of this receiving set is to chart or calibrate the secondary control knob for various wave lengths or stations. In some cases the manufacturers supply such data for their receiving sets. With this data on hand, the secondary control is set for the approximate wave length or the station desired, releasing both hands for the two remaining knobs. The tickler or regeneration knob is now adjusted until a slight hiss is heard as the primary or station selector control is tuned to the desired signal. Some radio authorities contend that this type of receiver should be used only when it is at a sufficient distance from other sets to preclude the possibility of interference, while other radio authorities claim that such a receiver can be made to minimize radiation and thus make it more desirable in crowded localities than the single-circuit regenerative receiver.

How the stage manager of the radio drama supplies the "scenic" effects

It is the regenerative receiver that is blamed for radiation troubles, while other types escape comment, as a rule. This, however, is unfair, and is based on an incomplete knowledge of radiation possibilities. Sets in which radio-frequency amplification is employed are sometimes guilty of radiation, because oscillations may be set up in the amplifier tubes. In the better types of radio-frequency receivers the oscillating tendencies are overcome by a potentiometer or stabilizer control or by some neutralizing device, such as the tiny neutralizing condensers of the well-known neutrodyne receiver. Where a potentiometer or stabilizer, as it is sometimes called, is employed, the operator should remember at what points the potentiometer or stabilizer is placed to remove the whistle in his own 'phones or loud-speaker, and always move the potentiometer up to that point before adjusting the tuning controls.

The simplest manner by which to tell whether a tube is oscillating or not is to tap the grid connection, and if clicks are heard it is an indication that the tube is exceeding the regenerative point. Sometimes one can obtain the same effect by tapping the antenna binding post of the receiver, but the grid is the only reliable contact. If one adjusts the set too far in regeneration, the signals become mushy and indistinct.

It is essential that all of us strive to overcome the present radiation evil which is ruining full radio enjoyment for many radio listeners-in, especially in crowded sections. Not only must radio sets be made with the minimum radiation possibilities, but everyone must learn how to tune any receiving set so as to preclude all chance of oscillation and radiation.

Protecting Tube Filaments

FROM a reader, Frederick A. Meyers of Philadelphia, comes an ingenious idea for protecting vacuum tube filaments against the full strength of "B" battery current through accidental contact or misplaced connections. All that is necessary is to secure a 110-volt 15 to 50 watt tungsten filament bulb and socket, and connect same in the B-battery lead, in series, of course. Ordinarily, the B-battery energy flows through the tungsten filament of the bulb without the latter showing any signs of such current flow. The resistance of the filament is insufficient to choke off the high voltage, low current consumption of the usual plate circuits. However, if for any reason the B-battery current should be diverted into the A-battery leads, then the high resistance of the bulb will immediately serve to choke off the excessive B-battery current to the extent of protecting the vacuum tube filaments. A carbon lamp does not seem to give as good results as the tungsten type. The lamp lights only when there is a short circuit or improperly connected B-battery lead, whereupon it should be unscrewed in its socket to break the current, and a search made for the cause of trouble.

The Scenery for the Radio Drama

IN order to make radio plays more realistic and give the necessary atmosphere, the special bell board shown in the accompanying view has been built for use in the WGY studio. The board carries a door bell, telephone bell, clock alarm, tap bells, buzzer and fire alarm bell, together with the operating push-buttons and dry cells. At the left is seen the portable door, which is placed near the microphone and serves to furnish the sounds of a door being opened and closed, even to the handling of the keys and fumbling for the door knob. The microphone is located under the silk shade of what appears to be a floor lamp, for the sake of the temperament of the radio players.

Can the Neutrodyne Be Improved?

WHILE admitting the numerous advantages of the neutrodyne, especially as a basic circuit, it is fair to consider what can still be done to this circuit to make it still better in the future. And no one is better qualified to pass an opinion on this question than Prof. Hazeltine himself, the designer of the neutrodyne circuit who writes in part as follows: "Probably almost every one who has operated a neutrodyne receiver has noticed that the three tuning dials read nearly alike for each wave length setting and has had the idea that these three adjustments might better be made simultaneously by gearing the dials together, or, better, by mounting the rotors of the three tuning condensers on the same shaft. If this could be successfully accomplished, tuning would be vastly simplified, and it would be impossible to pass through a station which was broadcasting without hearing it. Two limitations have prevented this desirable arrangement in the past: First, the manufacturers of condensers have not succeeded in making them absolutely uniform; and, secondly, the users may employ antennæ of various capacities, thus affecting the tuning of the antenna circuit. If the manufacturers succeed in overcoming the first difficulty and in adjusting the condensers to agree throughout their scales, the second difficulty may be overcome by making the antenna a part of the set. This leads us to an arrangement which we may imagine as the ideal neutrodyne of the future—a receiver unit mounted with the batteries near the top of a cabinet three or four feet high and standing on the floor, the antenna consisting of a vertical rod extending from the receiver unit to a metal shelf near the floor level. . . . Such a set would have no external wiring whatsoever and could be rolled freely around the floor to any desired position."

The Sugars—What Are They?

THE LAYMAN generally knows of but one sugar, the kind that he uses in his tea or coffee; the chemist, on the other hand, knows this type of sugar to be only one member of a large class of substances which he calls the sugars. In other words, there are many substances which belong to this class, although they are usually known by different names and although only one of them is properly called sugar in common parlance.

There is a rather interesting story in connection with the first appearance in Europe of the substance, sugar, which bears retelling. The Greeks, as was their custom, had a story to tell about a wondrous reed which yielded honey without bees. They were fond of such tales and cared but little if they were true, just so long as they were interesting and entertaining. They did not believe very much in this one, but it happened to be true, for this wondrous reed was nothing else than the sugar cane, which was known at that time in the Far East. It was eventually brought into Europe by the Arabs when they invaded Spain and was called by them "sukkar" or sugar.

This is the sugar that is known to everyone and was for a long time the only sugar commonly consumed. Chemically, it is called sucrose and it is the sweetest of the whole sugar family. It was not until the middle of the eighteenth century that a German chemist conceived the idea of extracting sugar from the sugar beet. This is now a great industry both in this country and abroad. Beet sugar, as well as cane sugar, is sucrose. Great quantities of these sugars are consumed each year throughout the world.

But, as has been mentioned above, there are other important members of the sugar family, which are also characterized by a sweet taste, and which are sugars in the strict chemical meaning of the word, but which the layman knows under other names.

The most common of these is glucose, or dextrose as it is called scientifically. Glucose, also known as grape sugar, is not as sweet as sucrose, but is just as good food as the latter. Sucrose, when subjected to chemical treatment, can be made to split up into two simpler sugars, one of which is dextrose or glucose and the other is known as levulose or fructose. These two sugars are identically alike, except that one possesses the property of turning the plane of polarized light to the right and the other to the left.

Glucose is the sugar that is made by chemically treating starch. Corn starch is commonly employed for this purpose, although potato starch may also be used. The starch is treated with dilute acid, the latter being entirely removed by after-treatment. Glucose is the sugar that is employed to a large extent in making candies and soft drinks. It also has technical uses as, for example, in the manufacture of chrome-tanned leather, as an ingredient of certain dye liquors, in treating tobacco and tobacco products and the like.

Levulose or fructose, also known as fruit sugar, is said to be sweeter than sucrose. It is the sugar that is found in honey. It is obtained commercially from invert sugar, which is merely a mixture of glucose and fructose, not combined chemically.

Two other familiar sugars are maltose and lactose. Maltose is the sugar that is obtained by the action of certain substances, which are known as enzymes and which are characterized by the fact that a minute amount of them will cause enormous masses of other materials to undergo chemical change. Thus, diastase by its enzymotic action on starch, produces the sugar maltose.

Lactose is the sugar that is found in milk. It is obtained from the whey which is left over in the manufacture of cheese. Both lactose and maltose are largely used in making infant foods. There are other sugars, such as mannose, galactose, arabinose, raffinose and the like, that possess only academic interest and are not made on a large scale nor used for any special purposes except in some cases as medicaments.

A Marine Traffic Policeman

NEWTOWN CREEK, between Long Island City and Brooklyn, is a very busy waterway, and to conserve time of tugs and tows, a marine "traffic" officer has been appointed and the results have been astonishing. Regulations in printed form are given to the masters of all craft navigating the creek which resulted in much elimination of confusion and delay.

Textile Fibers—How to Tell Them Apart

THERE are in the main four textile fibers: cotton, linen, silk and wool. The first two are of vegetable origin, that is, the fibers are derived from plants that are grown either wholly or in part for the fibrous substance that is obtained from them. The last two are of animal origin, wool being shorn from the sheep, and silk being woven by the silk worm. From these four fibers, to which may be added ramie, hemp, and one or two others, there are obtained the multitude of fabrics that are employed in the making of clothes, coverings, and the many other purposes to which textile materials are put.

How to tell between the fibers and how to determine which of them are present in the finished textile is indeed a problem which the ordinary individual finds hard to solve and which also has its difficulties for the chemist and textile specialist. Is the all wool suit really 100 per cent wool or does it contain shoddy? Is this linen towel pure linen or does it contain cotton as well? Does the silk material bought for making a dress contain all silk or is a little cotton mixed with it? These and many other problems confront the purchaser each and every day. Here are a few simple tests which may prove of some value in helping the layman to tell what character of material he is buying.

In the first place, whether or not a woolen fabric is 100 per cent wool can only be told by the feel of the goods, which requires considerable experience, or by examination under the microscope which reveals clearly the broken and cut shoddy fibers mixed with new wool.

If silk and wool is mixed with cotton, the presence of the vegetable fiber can be told by the use of a solution of potash lye. This will dissolve the wool but leave the cotton behind. When a silk cotton mixture is tested, the same solution of caustic potash is employed, the silk being dissolved and the cotton left behind.

To determine whether a textile fabric is 100 per cent linen, the following test may be applied. A sample of the cloth is left in a little concentrated sulfuric acid for a period of one and one-half to two minutes. It is then removed and washed with water and treated with a solution of caustic soda. The caustic solution attacks the cotton and leaves the linen untouched. The presence of the cotton threads among the linen fibers can easily be told by the gaps that are left in the fabric due to the removal of the former.

In general, animal fibers can be differentiated from the vegetable fibers by testing with acids and alkalies, and by burning. The burning test is perhaps the simplest. It merely consists in igniting a sliver of fabric. If the fiber is of animal origin, it burns with the odor of burning feathers. Otherwise the odor is similar to that of burning paper or wood.

Alkalies will attack wool and silk and dissolve these fibers, but will not have a strong effect on cotton and linen. On the other hand, acids will dissolve cotton and linen and will not affect wool and silk.

One way of telling the difference between cotton and linen, when it is uncertain what fiber the fabric is made from, is to tear a sample. The tear in the fabric will leave straight threads if the fabric is linen, but curled threads if the fabric is cotton. Another test that may be employed to determine between cotton and linen is to allow a drop of glycerine to fall on the fabric. If it is cotton there is no change produced therein, but if it is linen, the fabric is made transparent.

Curiosities of the Post

OUT of 52,000 post offices in the United States there is only one New York, although there are 2_ Washingtons, 25 Clevelands and two Chicagos. Names like Clinton, Chester, Lexington, Oxford abound. Names of Presidents are numerous as are names of the world's capitals. "Fancy" names like Eureka, Arcadia, El Dorado, etc., seem to be prime favorites. If you put "New York, U. S. A." on a letter, it is sure to be delivered.

When Is Lead Lead, and When Is It Carbon?

LEAD is known to be a heavy, soft metal. It can be cut with a knife and when drawn across a piece of paper it deposits a grayish black streak. Lead is a metal that has been used for a long time, and when the substance commonly called graphite, plumbago or "black lead" was first employed to make pencils, it was natural that these writing implements should have been called lead pencils because they left a black mark on paper. However, there was not a particle of the metal, lead, in them. Thus we have the common misnomer, "lead pencil," and many today still think that lead is used in the "lead pencil."

Lead is a metal of many uses, but it is an entirely different substance from graphite. The latter is found in the earth but never in the pure condition, and in only a few localities at that. The island of Ceylon is famed for its graphite deposits among other things. Nearly all of the graphite that is used in this country today—and a great quantity of it is employed for various purposes—is made by an electrical process from anthracite coal.

Graphite is simply a form of carbon. Carbon is a highly important chemical element. Its most familiar form is coal, but it appears in quite a number of different conditions, all alike chemically—all being carbon and nothing else—but entirely different physically. Thus, the diamond is a form of carbon, as is graphite, which is a black, opaque substance with a metallic lustre, possessing different degrees of hardness. Charcoal is carbon, and so is coke, and again lampblack, the substance that is obtained by burning oil in an insufficient supply of air or oxygen. In the intense heat of the electric arc, these substances are capable of being converted one into the other.

Graphite is used in making lead pencils but this is by no means the only use to which it is put. There are many other purposes for which it is used. It finds considerable employment in the electrical and allied industries, for it can readily be manufactured into electrodes and similar articles. It possesses the important property of being an excellent conductor of the electric current.

Graphite electrodes are made in all sizes and shapes, from the small ones that are employed in the electric arc light, to the large ones more than one foot thick, that are employed in electric furnace work. Various parts of electrical machines are made of graphite, such as commutator brushes, motor and generator parts, anodes for electric batteries, etc. It is employed to a certain extent as a substitute for platinum and nickel in making electrical machinery.

It has been found that when graphite is very finely ground to give an impalpable powder, it can be mixed with either water or oil to form a suspension which possesses important lubricating properties. These fine graphite suspensions are now employed to a considerable degree in lubricating machinery, the gears in automobiles, etc.

Graphite also finds employment in the manufacture of black powder, particularly in making sporting powders. Graphite paints are commonly employed in painting steel and iron structures. One strange use for this substance is as an ingredient of fertilizing compositions. It gives good results when employed as a boiler compound to prevent the incrustation of boilers with scale from hard waters. It is employed in the manufacture of crucibles which are used in high temperature work, as for instance in the manufacture of crucible steel.

The Size of the Flag

REVISED dimensions for the United States Flag have been decided upon by the Federal Fine Arts Commission, after conferences with a committee of Government officials designated for the purpose. The decision was reached after a series of tests made on the memorial flagstaffs at Arlington, where it was possible to display many flags side by side for purposes of comparison. The change is explained by the statement that the present flag is too long for its width, and that reducing the length will make it more artistic. The present proportions are 1.90 inches of length for each inch of width. The Fine Arts Commission has decided upon 1.67 to one.

Applied to the flag displayed at the Postmaster General's office—claimed to be the largest correctly proportioned flag in existence—the new proportions would involve a loss of approximately eight and one-half feet. This flag now has dimensions of 70 feet, 4 inches by 37 feet. The famous Star Spangled Banner of Fort McHenry, as preserved in the Smithsonian Institution, is now 34 by 30, and is believed to have had an original length of 36 feet, giving a ratio of 1.20 to one.

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Titanium Dioxide from Bauxite

A NEW process for manufacturing the important white pigment, titanium dioxide, which has now definitely joined the ranks of the white pigments employed in the manufacture of white paints and similar products, is described in British Patent, No. 181,775. The starting material in this manufacturing process is the mineral bauxite which is used in large quantities in the manufacture of the metal, aluminum. A mixture of one part by weight of finely divided bauxite and five parts of ammonium sulfate is heated to a temperature of approximately 350 to 400 degrees Centigrade under a pressure of from three to four atmospheres. Ammonia and water vapor are evolved, and double sulfates of ammonia with alumina and iron are formed. The mixture is then treated with water to dissolve out these sulfates, leaving behind silica and titanium dioxide in unaltered condition.

The pigment, titanium dioxide, is obtained in the state of a very fine suspension in the solution of the sulfates, and may be decanted from the silica and the undissolved bauxite which settle to the bottom of the reaction vessel. The titanium dioxide may then be filtered. The process is said to be suitable for treating bauxite which is rich in titanium dioxide. Such a product is obtained in certain regions of central India.

Petroleum Products from Slime

THE Research Organization of the Soviet Government has been investigating the possibility of obtaining oils and other products from the slime which is found at the bottom of the lakes in Central Russia and Turkestan. It is stated that they have been successful in distilling virtually every product usually associated with mineral oil deposits. Assuming that this is substantiated, it will be strong confirmatory evidence for the organic theory of the origin of petroleum deposits; though the commercial value of the discovery would appear to be but small.—*The Chemical Age* of London, 1924.

Pure Hypochlorites and Chlorates

A NEW method for the production of pure solutions of hypochlorites and chlorates by electrolysis is described in the *Zeitschrift fuer Elektrochemie*, 1924, volume 30, pages 67 to 72. This is accomplished by using cathodes which contain the metal chromium. The process seems to work out very satisfactorily on an experimental scale but it is still doubtful just what results can be secured with it in large scale operations. This will depend to a large extent on the durability of the iron cathodes which are employed in it. If they can be made to stand up against the corrosive action of the electrolytic solutions, there is every reason to expect good results from this process.

Waterproofing Agent for Leather

LEATHER is rendered waterproof without imparting to it greasiness or stickiness by a process which is patented in United States Patent, No. 1,470,-073. The leather that is produced in this manner is claimed to be eminently suitable for manufacture into shoe soles. The waterproofing composition that is employed in the process contains paraffin, rosin and rubber, preferably mixed with a softening agent such as castor oil. Coloring matter may also be added if desirable.

In making the composition, equal parts by weight of paraffin and rosin are melted together, heated to about 90 degrees Centigrade, thoroughly mixed and the rosin is oxidized by blowing air or oxygen through the mixture or by treating it with a non-gaseous oxidizing agent, such as nitric acid. The oxidation causes a precipitate to form in the molten mixture. The molten supernatant liquid is then separated from the precipitate, the latter being rejected. Then in eighty parts of the molten liquid there is dissolved ten parts of thoroughly masticated crude rubber by stirring the rubber in small particles in the molten mass or masticating it in the presence of the molten liquid. A softener is added to the mixture either before, after or during the addition of the rubber. Five parts by weight of castor oil have been found to be sufficient for this purpose. The resulting product is then permitted to cool and forms a wax-like solid which can be shipped and handled without any difficulty. When to be employed in waterproofing fibrous materials, it is first brought into the molten condition.

Impregnation is effected by simply dipping the material in the molten liquid or allowing it to remain immersed to attain the proper degree of saturation. Ordinary chrome tanned leather, for example, may be suitably impregnated for sole leather by allowing it to stand in the molten mass for a period of one to two hours at a temperature of approximately 85 degrees Centigrade. Such temperature is preferred as higher temperatures would tend to injure the leather itself.

New Uses for Potatoes

AT a meeting of the Vereins deutscher Kartoffeltrockner, which was held in the middle of February, Professor Parow made an interesting report on the possibilities of further use of the potato. It is well known that Germany had before the war an excess of potatoes. During the war there was a deficiency of these and through the Versailles treaty many regions in the east where potatoes were cultivated have been given up to Poland. But is spite of this, there are always potatoes that are poorly grown, frozen and no longer useful for eating purposes, for which a new technical use should be sought.

Aside from its use as food, fodder and seed, the potato formerly served as a raw material in the manufacture of alcohol, starch and yeast. It was also used in potato drying plants and in the manufacture of lactic acid. As has already been proven in France, experiments in the laboratory of the Forschungsinstitut fuel Staerkefabrikation und Kartoffeltrocknung, in Berlin, have shown that by the utilization of dried potatoes a palatable, strong beer is obtained. At least 30 per cent malt can be replaced by the dried potato, dried parings being better suited than potato flakes. The potato taste and odor completely vanish by cooking the wort.

Furthermore from dried and fresh potatoes a bleaching powder can be obtained that finds use in the bleaching of juices and alcoholic liquors. Formerly such a bleaching powder was made from charred bone, or wood and blood. For the production of bleaching powder the poorest, completely rotten potatoes as well as the spoiled dry potatoes, are used. This pure black bleaching powder, when mixed with oil of turpentine, makes a good shoe polish, so that the shoe polish industry is also to be taken into consideration as a purchaser for dried potatoes.—*Industrial and Engineering Chemistry*, volume 16, number 4, page 426.

A New Form of Carbon

A MATERIAL which is said to be intermediate between the diamond and graphite is described under the name of "glanzkohle" by K. A. Hofmann and C. Rockling, of the Charlottenburg High School. It has a silvery white luster. Though elastic, it is almost as hard as the diamond, and it is even more resistant to chemicals than graphite. It is prepared by passing the flames of certain gases, such as methane or chloroform, through small perforations in a heated material which is chemically inert, such as porcelain. The new material has an electric conductivity less than that of Ceylon graphite, and it resembles the diamond optically more than graphite. Purified by boiling with strong acids and fusing with sodium sulfate, it contains 99.06 per cent of carbon and 0.48 per cent of hydrogen. —*The Chemical Trade Journal.*

Artificial Shellac

CHEMIKER ZEITUNG, year 1924, number 23 and 24, reports on a new process of making shellac by synthetic method from acetylene which is first changed into acetaldehyde. The process is carried out by by Dr. Alexander Wacker Gesellschaft fuer elektrochemische Industrie m.b. H. in Munich. The acetaldehyde is first condensed and polymerized by the usual methods that are commonly employed for such purpose and a soft resinous substance is obtained. This substance is then polymerized again and thereby converted into a hard resinous mass which bears a certain resemblance to the natural shellac resin.

This product has appeared on the German market under the name of Wacker shellac. It finds use in the furniture industry for polishing and producing a dull surface on the furniture, in joinery and cabinet-making, in lathe work, furthermore in the gypsum and artificial stone industry as a binder and coating, as well as in the match industry as an adhesive to glue the head on the match, as an adhesive in the electrochemical industry and in the manufacture of spirit varnishes and insulating lacquers.

Russian Potash from Sunflower Ash

ACCORDING to Science Service in spite of crop failures and famine at home, Russia has been within the past two years exporting considerable quantities of potash. Russian potash is extracted from the rich soils of southeastern Russia by burning the stalks of sunflowers which are extensively grown in that region. Last year more than half a million acres of land were devoted to this purpose, the yield of potash being from 160 to 190 pounds to the acre. The Russian potash is purer than the German variety, which is mined from the earth, and, before the war, was successfully sold in Germany in competition with the local product, partly because of its better quality and partly because of its lower price.

Italian Lignite Coking Process

ACCORDING to L'Engrais, an Italian syndicate has been formed to exploit industrially a new lignite carbonization process recently invented by Professor Mondello. This process, the fundamental principle of which is the application of superheated steam, is said to give an excellent coke, free from sulfur and phosphorous, clean, hard, and of a calorific value of 6500 B. T. U. The yield of coke is 45 per cent, and excellent yields of ammonia and tar are also obtained.

Paris Green Used Against Mosquitoes

THE United States Department of Agriculture has made a report on the use of paris green against the mosquito pest. The paris green has been dusted on swampy land by airplanes, the experiment being made in Louisiana. In this experiment the paris green was diluted with road dust or some similar substance such as tripoli.

Gelatine as a Digestive Agent for Milk

A SHORT note in *Chemiker Zeitung*, 1924, numbers 5 and 6 states that gelatine has been advocated as a digestive agent or remedy for milk. The milk to which approximately 1 per cent of gelatine has been added does not coagulate or only with considerable difficulty. Such milk is particularly useful in the nutrition of children.

Silver and Gold Foil by Electrolytic Method

THE manufacture of silver and gold by an electrolytic method is described in *Chemiker Zeitung*. The first step in this process consists in giving a glass plate or a cylinder made from highly polished aluminum a coating with a solution of gutta-percha. When this film is thoroughly dry, a small amount of copper powder is brushed over it and then a thin film of silver may be electrolytically deposited on the same. The silver adheres tightly to the underlayer of copper. The silver layer is then highly polished and a coating of gold is formed thereon. In order to remove the coatings that are formed in this manner, it is only necessary to dip the metal object in a solvent which has the power of dissolving gutta-percha or rubber. According to this process it is possible to obtain coatings and films of gold on metallic objects, using only 0.005 to 0.008 gram of gold per 100 square millimeters of surface.

Sugar from Corn Starch

THE Bureau of Chemistry of the Department of Agriculture reports that sugar can now be made commercially from corn starch. It is estimated that one corn crop will supply the United States with sugar in sufficient quantities to meet all the needs for twenty years. The country's annual consumption of sugar is about five million tons for all purposes, about half of which is imported. According to the report it will be possible to stop this importation.

Atmospheric Heat as a Source of Power

A Suggestion of a Means by Which This Reservoir Might Ultimately be Tapped

By Haviland Hull Platt

ATOMIC energy is the phrase of the hour. No prophetic book or lecture is complete without speculation on the possibility of turning to account the vast store of energy contained in the atoms of all matter. The magnificence of this possibility seems to have resulted, for one thing, in concealing a much more commonplace source of power. All the matter around us continues to be at a high temperature relative to absolute zero. Every ten-foot cube of air contains more energy by virtue of its mere temperature than is released by the combustion of a pound of the best coal.

One class of phenomena resulting from molecular motion in gases is diffusion. A simple experiment of this kind is illustrated. Fig. 1 is a section through a closed vessel which is divided in the middle by a tight-fitting thin membrane *m*. This membrane is made of a kind of parchment that has the peculiar property of allowing nitrogen to pass through it readily although it is almost completely impervious to oxygen. We now fill the right-hand compartment with pure nitrogen and the left-hand compartment with pure oxygen, both at atmospheric pressure, the whole apparatus being at the uniform temperature of the surroundings. If the vessel is movably mounted, as on the rim of a balanced wheel, it will immediately begin to move in the direction of the arrow. Practically all the oxygen molecules that strike the membrane rebound from it, their direction of motion being, on the average, completely reversed. Some of the nitrogen molecules, however, pass through the membrane, and their direction of motion is obviously not reversed by impact with the membrane. The pressure on the walls of the vessel being the same everywhere, the unbalanced force on the membrane serves to move the whole vessel.

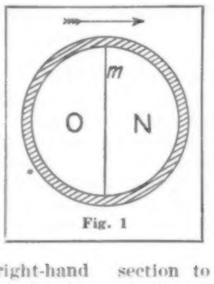


Fig. 1

So far we have been traversing well-trodden ground. But the permeability of the membrane used in the experiment described above is completely reversible—nitrogen molecules can pass through it with equal facility from either side. Let us suppose that we have a partially irreversible permeable membrane. This membrane allows the passage of both oxygen and nitrogen molecules but it allows them to pass through more easily in one direction than in the other. With such a membrane the conditions of the experiment could be met merely by placing the membrane in air at ordinary temperature and pressure. Therefore the problem of constructing a molecular engine resolves itself into the problem of making a partially irreversibly permeable membrane.

By means of a long mathematical treatment an English scientist has recently demonstrated that a funnel-shaped vessel immersed in a gas is more easily penetrated by molecules approaching from one end than from the other, provided the dimensions of the vessel are not greater than the mean free path of the gas molecules. The vessel shown in Fig. 2, for example, will allow more molecules per second to pass from A to B than in the opposite direction. A very thin membrane perforated with conical holes will, therefore, be more permeable in one direction than in the other and when immersed in air will be subjected to an unbalanced pressure in the direction of the arrows, Fig. 3.

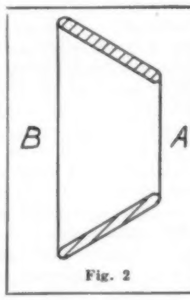


Fig. 2

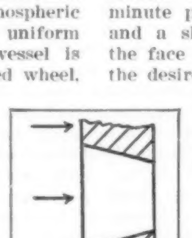


Fig. 3

Unfortunately the practical difficulties in the way of making such a membrane for common use are very great because its thickness and the diameter of its holes must be no greater than the mean free paths of the molecules striking it—that is, in the case of air at atmospheric pressure and temperature, about one one-millionth of an inch. Gold-leaf can probably be rolled as thin as this. The real obstacle is the punching of the holes.

One of several punching possibilities will be outlined briefly. The punch is to be constructed of two different materials. One of these is glass or a similar vitreous substance having a comparatively low melting point. The second must be a hard material, easily pulverizable, having a higher melting point than the glass. Furthermore, when in a fine powder it must be capable of a very intimate mixture with molten glass, and it must be chemically inactive with respect to some reagent, such as hydrofluoric acid, which readily attacks glass. The method of procedure is to reduce the second material to a powder most of whose particles are less than one one-millionth of an inch in diameter, to mix this powder thoroughly with a mass of molten glass, to allow the mixture to harden in a suitable mold, and to polish one face of the block as smooth as possible. The polished surface is next acted on by, say, hydrofluoric acid. The glass is dissolved but the dust particles remain. With a reagent of suitable strength acting for the proper time we may expect the section to assume a surface configuration similar to that shown in Fig. 4. Each minute projection should act as a punch and a sheet of gold-leaf pressed against the face should therefore be perforated in the desired manner. While the dimensions involved are very small they are not entirely beyond the range of a powerful microscope. It is therefore possible that visual observation may be used in the development of such a process.

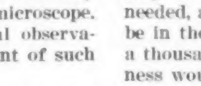


Fig. 4

Luckily, because the mean free path of a gas increases as the pressure decreases and because there are other gases with considerably longer paths than those of oxygen and nitrogen, an experimentally operative membrane is more easily made. Thus helium at the easily realizable pressure of one ten-thousandth of a pound per square inch has a mean free path of nearly half an inch. So it is a simple matter to make a metal sheet with holes small enough to be operative inside a laboratory vessel connected to a vacuum pump, and it is probable that the actual conversion of molecular energy under such conditions will soon be an accomplished fact. From this beginning we can expect the technique to be worked out for higher and higher pressures, with atmospheric conditions as the final goal.

Supposing that this goal will be reached, how will such a membrane be used and what will be the consequences of that use? A sheet of gold one one-millionth of an inch in thickness is so flimsy that reinforcing would be the first requirement for its use as a means of propulsion. A fine-meshed wire screen would serve the purpose, the membrane being cemented to the screen in spots or held in place by its own unbalanced pressure. Vanes, each comprising a membrane with reinforcing screen, could be made in convenient sizes and assembled in batteries. For most purposes these would be encased in cylindrical shells, rotatably mounted. A section through such a cylindrical battery of membranes is shown in Fig. 5. The membranes are rigidly held so that their unbalanced pressures are all exerted in the same direction. The combined result is a force tending to displace the entire cylinder, the amount of the force depending only on the area of the membrane and its effectiveness.

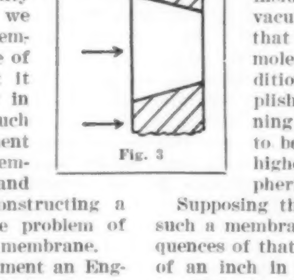


Fig. 6

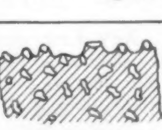


Fig. 5

The design of a molecular engine containing four cylinders is shown diagrammatically in Fig. 6. The four cylinders, *C*, containing the membranes are rotatably mounted on the arms of a spider, *S*, which is fixed to the shaft, *R*. The whole rotor is enclosed in a casing *A*, which has an exhaust passage, *E*, and an inlet in one end near the shaft. The four vanes, *V*, mounted on the spider, serve the purpose of a fan to keep the air in the casing moving with the rotor. Simple mechanical devices for turning the cylinders to any desired positions are provided. In starting the engine and for full power operation the cylinders are turned so that the force of each is exerted in the direction indicated by the arrows. The air in the casing will move with the rotor and the centrifugal force will maintain a continual flow of air through the casing. When the desired speed has been attained the acceleration is checked by turning the cylinders to positions in which the line of pressure is diagonal instead of perpendicular to the desired direction of motion, the effective torque being thereby reduced. To stop the engine two of the units are turned to oppose the other two rotationally. To reverse, all the cylinders are merely reversed from their original positions.

A membrane having a degree of irreversibility of one in ten thousand could be used in making an entirely practicable engine. In fact, so closely could these leaves be packed that an engine of 50 horsepower could easily be put into a space three feet square, although the first cost would probably be high on account of the great area of gold-leaf needed, about one thousand square feet. The cost would be in the making and not in the material, however, for a thousand square feet of gold-leaf of the required thinness would weigh only three or four ounces.

Space is lacking to detail any of the multitudinous applications of such an engine, if it could be reduced to practice. One suggestion is of so extraordinary a nature, however, that it must not be omitted. The cylinders should provide a direct force considerably in excess of their own weight. They could therefore be used in place of the gas bags of balloons. Forward motion would result from merely turning them to exert some of their force in that direction. Thus individual airships with perfect control ought to be possible. After alighting, the operator could walk about without removing the machine from his person—the normal position of the cylinders would be set to pull upward just enough to relieve him of the entire weight of the machine.

Who Goes to College Nowadays?

IF you think that the butcher, the baker and the candlestickmaker do not appreciate the value and importance of a college education for their children, you should consult the registration records of some prominent state university and find out who goes to college nowadays. Recently a survey was made of the eleven thousand students who attended the University of Illinois to determine the business occupations of the parents of the students. Approximately 30 per cent of the students reported that their fathers were farmers, while skilled and unskilled labor was represented by 1399 parents, of which more than 100 were listed as "laborers."

Forty-four of the parents were newspaper editors or publishers, 10 were hotel managers, while 13 were occupying offices of distinction as presidents of manufacturing companies, banks, academies and colleges. Altogether business of some sort or other claimed the attention of 3175 of the parents. Eight hundred and eighty-five were professional men and 320 were specializing in scientific work. Two hundred and ten were railroad men and 302 others were retired. Some of the miscellaneous occupations recorded in this novel survey were: 7 artists, 14 musicians, 34 mail carriers, 19 postmasters, 2 theater managers, 21 blacksmiths, 31 barbers, 3 chauffeurs, 4 chefs, 4 lake captains, 55 miners, 37 painters, 35 plumbers, 2 hotel porters, 4 junk dealers, 5 cemetery sextons, 1 waiter and 11 watchmen. One student gave his father's occupation as "capitalist." There were also on the list 146 clergymen, 265 doctors, 11 policemen and not a single burglar. It seems pretty clear that the answer to the question of the title is "everybody who thinks he can afford to."

Muscular Action in Work and Play

Some of the Factors Involved in the Simplest Series of Bodily Movements

By Guy Otis Brewster, M.D.

The human body has been called the most marvelous machine in the world, and we are prone to accept it as just this. But how many have ever paused to give thought to the fact that each and every one of us is the engineer in charge of one of these super-machines? We do something like walking or throwing a ball, which we regard as an extremely simple action. In terms of the machine, however, it is enormously complicated, so that we might well wonder how we ever carry it to a successful issue. Dr. Brewster gives us some idea of the complications involved in every muscular action, and of the way in which the situation is handled anatomically.—The Editor.

PLAY ball! The pitcher is on the mound, ball in hand, winding up for the first pitch of the game. All eyes are centered upon him as he hurls the ball toward the plate. What happens to his body? What muscles does he use? And why are some pitchers invincible, while others are batted from the game in less than an inning?

As the pitcher grasps the ball, he contracts the flexor muscles of his forearm, which closes his hand upon the ball. His arm is pulled upward by the deltoid muscle which covers the point of the shoulder. The shoulder is drawn backward by the trapezius muscle which covers the upper part of his back. The forearm is drawn upward by the biceps muscle which lies on the front of his upper arm, assisted by the pectoralis or breast muscle. The shoulder is rotated by the serratus magnus or rib muscles, and the arm extended by the triceps muscles on the back of the upper arm, with the finishing stroke downward of the latissimus dorsi or hammer-blow muscle fastened to the hip, the ribs, and upper arm. The extensor muscles of the forearm open the hand and the ball is on its way. If a curve ball is thrown, the hand is turned slightly up, down, in, or out, and the pressure on the ball regulated by the rotation and flexor or grasping muscles at the moment the ball is released from the hand.

Now, isn't this a complicated jumble of motions for a man to go through every time he hurls a ball toward the plate with the intention of getting it past the man with the bat?

And, as though the pitcher's act was not involved enough in the use of the principal muscles named, we must note that many smaller muscles of the hand, arm and body, are also called into use, with the further use of back and leg muscles to steady and give force to the throw.

When these complex movements blend in perfect harmony, or rhythmical movement, we call the action one of perfect coordination, and twine the laurel wreath about the brow of him who possesses it, for he is the invincible pitcher, the man who varies his speed, and curves with such control as to baffle the opposing batsmen's efforts to hit the ball safely, if they hit it at all. The incoordinate pitcher passes early to the showers, for while he may be effective at times his unsteadiness overbalances his good innings and his team can never feel sure of him. Can an incoordinate individual become coordinate? Yes! but that is another story. At present we are concerned with the normal action of the muscular system.

Here we go! The pitcher passed the first man up and he walked the first few steps toward first base, then trotted the remainder of the distance. What happens to his body at this time? Or, in other words, what is the process of locomotion?

When the man starts walking toward first base, he keeps one foot on the ground and one in the air all the time; and when he runs, he has both feet off the ground part of the time. In running, we lift ourselves on our toes with the muscles of the calf of the leg. The large thigh muscles kick the lower leg forward. The hip and buttock muscles rotate the thigh forward, and separate the legs. The muscles on the inner sides of the thigh pull the legs together. The belly muscles help pull us forward, as in bowing. Therefore, in running, we bend forward as though bowing, kick out our lower leg, rise on our toes, and pull or claw ourselves up into the air to land some distance forward. The repetition of this process we call running. Jumping is only an exaggeration of running, in which the run is halted, and all one's energy concentrated in a flight through the air, with no heed or conservation of energy for the next forward leap, as in running.

Dancing, as performed by folk-dancers and stage folk in general, is a normal muscular action, but there are more incoordinate and restricted methods of muscular action in dancing than in all other human activities combined. The common push and pull method used in one-stepping is far removed from the normal use of the muscles of locomotion used in walking, running or jumping, a normal combination well represented in either folk or clog dancing. Modern social dancing rather restricts free muscular action and doubtless enables many incoordinate, half-crippled people to keep a semblance of time with the instrumental noises used for the purpose.

In this form of muscular action, the hip and buttock muscles are alternately contracted and relaxed with the aid of the abdominal and thigh muscles. The lower legs and feet are dragged around in an odd admixture of the incoordinate actions of locomotor ataxia and spastic paraplegia. The physiological action resulting from this strange or strained use of both muscles and imagination would make a book.

In standing erect, we use the large muscles of the back, which are called the erector spinal mass.

The act of swallowing is a wonderful performance. Did you ever wonder what happened when you wished your food toward your stomach, or marvel that it did not come out of your nose instead of going down to the stomach? Or ask yourself why it got in the windpipe at times, and occasionally some liquid actually went up and came through the nose instead of going down?

In swallowing, the tip of the tongue becomes fixed against the front teeth or the roof of the mouth. The muscles on either sides of the tonsils, called the Pillars of the Fauces, contract and rotate the tonsils inward, grasping the food contents and narrowing the passage by drawing the soft palate up and back and tightening it. The muscle at the root of the tongue called the omo-hyoid, draws forward the back of the pharynx or upper part of throat, which shuts off the space up behind the nose. The epiglottis or trap door to the windpipe is closed by the lower throat muscles and the food thus pressed out of the back of the mouth is pushed into the esophagus or stomach tube which by muscular action carries food and liquids down into the stomach. The entire process occupies only about one-half a second from mouth to stomach.

Somehow or other, we all get tangled up on the breathing question. Our natural tendency seems to be to draw air into the lungs and swell out the chest. The chief breathing muscle is the diaphragm, which forms the dividing wall between the chest and abdomen. In its natural position it is humped up in the middle, like the back of a scared cat, with the hump pointing upward toward the head. When we breathe, we push it downward enlarging the chest cavity, which permits the air to enter the lungs and expand them in accordance with the increased space in the chest cavity. In pushing down the diaphragm muscle, we push out the abdomen and lift up the ribs with the chest muscles, front, side and back. In expelling the breath, the diaphragm rises, the ribs fall, and the abdomen is drawn in. This increases intestinal action as well as supplying air to the lungs.

Now, I wish I could fill my lungs with air and let out a wild yell to startle you into a state of attention, while I tell you why you yawn, which you may be doing by this time.

Yawning is one of the best unknowing things we do for ourselves, in the way of muscular action, and I often give thanks that no legal prohibition or tax has been placed upon it, and that only the ban of bad manners has thus far inhibited this valuable aid to health. When we yawn, we lift the arms, open the mouth and nose, lift up the ribs, push out the abdomen, stretch out the legs, and bring about all the principal muscles of the body into action. Why does this seem to rest us as signified by our contented sighs after the gap and stretch is completed? Try it once. Stretch out good, hold it, and as you relax, stretch your imagination and hold it open until you soak up the marvelous phenomena of yawning.

When you fill the lungs with air, you increase pressure in the lungs and abdomen and decrease pressure in the chest cavity which the lungs do not fill. This increased pressure in the abdomen and decreased pressure in the chest cavity outside of the lungs, hastens the flow of lymph up the thoracic duct into the heart by way of the subclavian vein and vena cava.

Here, you say, wait a minute! Who is this thoracic duct? I don't blame you for calling me to attention on this point. The thoracic duct, like the unknown benefactor who sends you a ton of coal when you are freezing, is a friend indeed, but of whom you know very little. It is the reservoir of the lymphatic system and carries the digested fats and valuable body building materials called lymph to the heart. The addition of these valuable materials to the circulation stimulates the heart's action and increases blood circulation. You will understand this stimulation to the circulation by noting that a heart removed from the body, kept at body temperature, and supplied with fresh blood and lymph, will keep beating for hours, and this with all nerve connection to the brain and spinal cord severed.

Instead of going to the ant for wisdom, watch your cat stretch and yawn, and go and do likewise. Perhaps it would not be a bad idea to popularize the seventh inning stretch at baseball games with a hands up yawn or two, and carry the idea into society until the deleterious custom of smothering yawns is overcome.

The use of the breathing muscles in regular, sustained action can now, I trust, be understood to supply air to the body as part of the job, and to further vitalize the human machine by increasing the blood and lymph circulation, thus accomplishing the vitamine marvel beyond the dreams of yeast makers, without money and high-priced drugs.

If there is anything in this screed which incites you to contrary action, you may return to the first part of the article and use your combination of hurling muscles to throw it at the cat.

Artificial Cell Culture and Cancer

BY growing cells outside the body for many years in his research laboratories at Washington University School of Medicine Hospital, St. Louis, Mo., Dr. Montrose T. Burrows is gaining new light on the cancer problem. His apparatus makes it possible to keep cells alive, active or growing for an indefinite number of years. Dr. Burrows found that cells normally form a substance which, if present in sufficient amounts, will cause them to grow or migrate. If the circulation is too rapid this substance is removed before the cells have undergone its effect; but if the circulation is slowed up, growth or migration occurs. This explains why a well-exercised muscle gets hard and larger, because the contractions of the muscle cause momentary interference with the circulating blood and retains the substance long enough to cause the muscle to grow.

It was further found that coal tar has the power to attract cells away from their normal blood supply sufficiently to cause them to grow and multiply. These cell clumps thus formed enlarge and soon are perceptible as tumors of a cancerous nature, and can be transplanted into other animals for an indefinite number of generations.

In the medical world old age is noted for its defective circulation and cancers. Dr. Burrows has demonstrated that if an extract of a cancerous tumor is injected into skin which has its circulation impeded in a manner similar to that of old age, a cancer forms. Cancers frequently occur in pigmented warts or moles when their already deficient circulation is interfered with by natural changes of old age. Their exposed location predisposes them to irritation and injury which may be sufficient stimulation to cause a rapidly spreading cancer. Since this discovery that cancer may be produced by anything which causes a rearrangement of cells in the presence of a defective circulation, it is possible that medical science will soon find methods of administering its most effective treatment and prevention.

The Heavens in August, 1924

The Opposition of Mars—Nearest for Years Past or to Come

By Professor Henry Norris Russell, Ph.D

THE principal astronomical event of this month is undoubtedly the very favorable opposition of the planet Mars. Oppositions of Mars, in themselves, are common enough; the earth, in spite of the stern chase which she has to make, catches up with her slower-moving brother at intervals of a little more than two years. But since the orbit of Mars is eccentric, his path comes nearer ours on one side of the sun than on the other. The nearer Mars is to the sun when we come in line with him, the nearer he will be to us, and the better we can see him.

On the present occasion things are about as favorable as possible. Although the opposition comes on the 23d, a week before perihelion, when Mars is 33,000 miles farther from the sun than on the latter date, the eccentricity of the earth's orbit puts us 86,000 miles farther from the sun than we would be when in line with Mars' perihelion. This amounts to nothing, compared with the planet's distance of 34,600,000 miles; yet it is interesting to know that we shall be nearer the planet, on the night of the 22d, than we have been or shall again be within the lifetime of most of our readers.

More important for observation, at least in this hemisphere, is the fact that Mars is much farther north than he would be if his opposition had come earlier. Though in 18 degrees south declination, he rises fairly high in our heavens, and is not ill placed, although southern observers still have a notable advantage.

Being so near the earth, Mars naturally appears large, and bright. To the eye he is of magnitude —2.7, which means that he looks nearly three times as bright as Sirius, and twice as bright as Jupiter. No other planet ever shines so brightly, except Venus, who, however, outshines Mars four-fold when she happens to be at her best, as she is this month.

With a telescope, Mars shows a disk 25 inches in diameter—two-thirds as big as Jupiter looks this month, and half again as big as Saturn. This is large enough to show plenty of telescopic detail. Yet when we think that, even now at his best, Mars looks only as big as a one-foot globe half a mile away, we realize that we cannot expect too much.

Under the very best conditions, two black dots 50 miles apart on the planet's surface could just be seen separately—if each of them was 30 or 40 miles in diameter. Looking at the moon under similar conditions, we could see the largest of the craters upon her surface, but could get only an imperfect idea of the roughness of her topography—though the outlines of the light and dark areas upon her face could be made out in considerable detail.

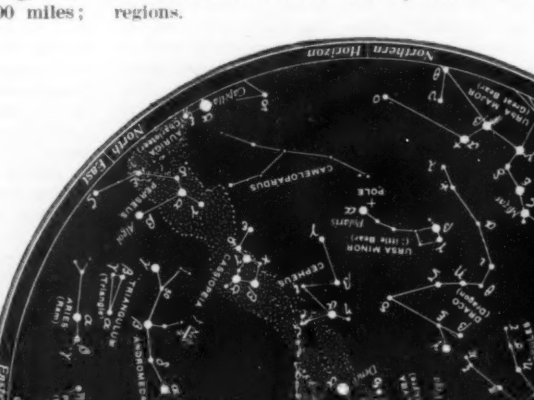
Our belief that Mars has a much smoother surface than the moon depends, therefore, not so much upon our failure to see the mountains by direct observation, as upon the measures of brightness, which show that the planet falls off much less in light, as the phase departs from the full, than the moon does (allowing, of course, for changing distance); and hence that the number of shadows on the surface, too small to be seen individually with any telescope, must be much less on Mars than on the moon.

What We May Hope to Observe

Much may be seen, however, even with a smallish telescope. The planet's south pole is tipped well toward us—about 16 degrees; and the Martian season corresponds to late November on the earth. This means spring in the southern hemisphere, so that the polar cap should be large, and steadily shrinking. To follow this, and to watch the changes in the larger dark markings, as they are carried across the disk by the planet's rotation, will be within the power of a moderate instrument, when the air is steady. The novice must not be disappointed, however, if he sees little at first, for the details on Mars are not hard black-and-white like those on the moon, but half-tones; and the full ones are much less conspicuous in point of fact than it is necessary for the sketcher to represent them on the drawings.

Professional astronomers, of course, will not neglect the unusual opportunity. Direct visual observations will doubtless be made in abundance, as at many past oppositions. But more attention will probably be given than ever before to investigations of other spots. Photography—already brought to remarkable perfection at the Lowell Observatory—will give a permanent record of the markings (except, of course, the finest details); and there is reason to hope that Mr. Slipher's recent success in photographing a white area on the surface which disappeared in a few days, and seems almost certainly to have been cloud or fog, will be duplicated.

Measures of the heat radiated by the planet are planned, both at the Lowell Observatory and at Mount Wilson. With the large disk now presented, it should be possible to get much new information, not merely about the temperature of the planet as a whole, but regarding the differences between the equatorial and the polar regions.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.
At 9½ o'clock: Aug. 29.
At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

By spectroscopic observations the difficult problem of the presence or absence of water-vapor and oxygen in the planet's atmosphere will again be taken up. The best attack follows the line devised independently by Lowell, Campbell and St. John, and demands spectrograms taken, not at opposition, but some time before or after, when the planet's change of distance from the earth shifts the lines which *may* be produced in its atmosphere clear of those interfering lines which certainly *are* produced in our own. If the new ruling engine at Pasadena turns out such a grating as there is reason to hope for, we may find ourselves near a solution of this problem before next year.

The Heavens

But we must turn from these things and take our usual view of the heavens. We shall find Mars, at our customary hour, well up in the southeast, and so bright that he dominates all that part of the sky, and quite outclasses all the stars of Aquarius, among which he is moving. Jupiter, though not so brilliant, is almost as dominant in the southwestern sky, though nearer the horizon. Below him we see Antares and the remaining stars of Scorpio. To the left comes Sagittarius, then Capricornus and the Southern Fish, with Fonalhaut almost below Mars. Higher up is Aquila, with the small but easily recognized groups of Delphinus and Sagitta above on the left and right. Cygnus is right overhead, and Lyra just to the west. Hercules, Corona and Bootes fill the western sky, and Ophiuchus and Serpens the southwest. Draco and Ursa Major are in the northwest, Ursa Minor in the north, and Perseus, Cassiopeia and Cepheus in the northeast. Aries, Andromeda and Pegasus, in the east, bring us back to our starting point.

The Planets

Mercury is an evening star this month, and fairly well placed, though south of the sun. On the 15th, when at his greatest elongation, he sets at 7:50 P. M., and should be easily seen.

Venus is a morning star, rising about 2 A. M., and very bright indeed.

Mars is in opposition on the 23d as already described, and is visible all night long.

Jupiter is in Scorpio, and sets about 11:30 P. M. in the middle of the month—before midnight, though he is not yet in quadrature, because he is so far south.

Saturn is an evening star in Virgo, setting at 9:40 P. M. on the 15th.

Uranus is in Pisces, approaching opposition, while Neptune is in conjunction with the sun on the 12th, and is invisible.

The moon is in her first quarter at 10 P. M. on the 7th, full at 3 P. M. on the 14th, in her last quarter at 4 A. M. on the 22d, and new at 4 A. M. on the 30th. These hours, like others given in these articles, are in eastern standard time, without allowance for daylight saving.

Our satellite is in perigee on the 11th, and apogee on the 23d, and is in conjunction with Neptune on the 1st, Mercury on the 2d, Saturn on the 6th, Jupiter on the 9th, Mars on the 15th, Uranus on the 16th, Venus on the 26th, Neptune again on the 28th, and Mercury on the 31st.

There are eclipses at both the full and new moons, the first total, the second partial, but neither is visible in the United States. The lunar eclipse on the 14th is visible almost throughout the eastern hemisphere, while the solar eclipse of the 29th can be seen only in northern Asia, Iceland and Greenland.

There is an occultation of Mercury on the 2d, the planet disappearing behind the moon's dark limb, for observers in Washington, at 5:19 P. M. (local time), and reappearing at 5:48. As it is broad daylight at these hours, the phenomenon can be seen only with a telescope.

Venus is also occulted on the 25th, but only for observers in the far north. As seen from the United States, the planet will be some distance south of the moon.

Pressures at the Sun's Surface

IN a paper presented before the National Academy of Sciences, Drs. Henry Norris Russell and John Quincy Stewart discuss the methods available for estimating the gas pressures prevailing at the sun's surface. They list eight of these, and present new data in the consideration of the sharpness of spectral lines that are sensitive to pressure, the absence of scattered sunlight in the flash spectrum, the widths of the Fraunhofer lines, and ionization and chemical equilibria in the solar atmosphere. All lines of evidence agree with the conclusion that the total pressure of the photospheric gases is less than 0.01 terrestrial atmosphere, and that the average pressure in the reversing layer is not greater than 0.0001 atmosphere. It is probable that the chromosphere is supported by radiation pressure, and that the gas pressure at its base is of the order 0.0000001 atmosphere. The whole amount of matter above the photosphere is of the order 0.0001 gram per square centimeter, equivalent to a layer of ordinary air ten feet thick. Similar considerations apply to the great majority of stellar atmospheres. The complete paper appears in the *Astrophysical Journal* for May, 1924.

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Rats—and Razor Blades

To the Editor of the SCIENTIFIC AMERICAN:

Speaking of rats, I wish to call your attention to a discovery I have made of a rodent exterminator, which consists of placing old safety razor blades in rat holes, and other places where the rodents hold forth. Care should be exercised to see that the blades do no harm to humans or to cats. There are enough old safety razor blades in this country sufficient to exterminate all of the rats in the world if properly placed around in their haunts and especially in their holes.

ROBERT MCCOUNT.

Highland Park, Cal.

A Suggestion for Our Railroads

To the Editor of the SCIENTIFIC AMERICAN:

The articles published of late in the SCIENTIFIC AMERICAN regarding railway container-car systems, recall to my mind the remark of a traveling salesman who had been on the road some twenty years, twelve of which he said he had spent in Goshen waiting for the train. Goshen is a junction place of perhaps forty inhabitants on the S. P. main line, six miles from here.

I remember spending fifty minutes there. It was while four trains—one from each direction—exchanged passengers and transferred mountains of baggage and express. There are possibly fifty regular hand-power baggage and express trucks at Goshen and when the four trains arrive all at about the same time, these trucks are busy and everybody connected with the two services is working like mad.

I do not know just the expense per hour of keeping trains waiting at stations. It must be a serious amount in total. Each passenger may figure for himself the value the lost time of waiting has to him. Added to the actual cash value of the wait is the not too good mental state induced. The passenger's impatience with all concerned; the lengthened time schedules of many hours; the large corps of helpers kept only partially busy at terminal and junction points; goods handled too rapidly for safety and proper shipping, are among the disadvantages of the present methods.

If the container system is a time-saver in car shipments why cannot a modified form of the same be used to speed up baggage and express transfers?

I have not been able to work out in detail a plan but believe one could be made workable by having an extra movable frame on top of the usual trucks that would be shifted bodily into the cars with its load. The load to be arranged and systematized in the car by the employe between stations and the frame filled with goods or trunks for the next stop. Certain details of the plan make it look unwieldy, such as the storage of the frames on the cars, etc. More formidable disadvantages than these have been overcome. Such perishable goods as peaches and other fruits accumulate in enormous quantities at certain shipping points during the season, and have to be loaded box by box by two men, delaying the whole train at times a full hour. By the use of loading devices completely attended to before the arrival of the train, these goods could be handled practically in bulk and with little delay. Trunks piled so high on trucks that the baggage man has to jump to push the top-most one over on to the ground could be piled a little lower and wheeled directly and bodily into the car.

The railway companies have a serious problem confronting them in the competition of motor trucks, which in this vicinity carry packages of fifty pounds or so, forty miles, delivering at your door all for fifty cents, and the next day after ordering, too. If coming by rail, the local drayman charges the same amount for bringing the package from the local station, other charges being extra.

A lengthened Ford weighing a ton can carry seven passengers and a driver, traveling on tax free pavement, paying practically no taxes on the machine with a weight of about 250 pounds per passenger. The railway is lucky to have 40 passengers in a 90-ton Pullman, fully taxed, riding on a track fully taxed, and further handicapped by being regulated by numerous political bodies, some of which are not especially anxious to save money for the railroads.

The railroads are certainly due to make some radical changes if they are to remain.

Visalia, Cal. H. L. WHITED.

The Breakage of Gage Glasses

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Charles Edward Prior, Jr., gives an explanation that is correct as far as it goes, as to the breakage of gage glasses. May I complete the matter?

The nature of glass is that of a liquid that has been cooled until so viscous as to be "solid," but without forming crystals. The cohesion of liquids is greatest at the surface; this is familiar in the cases of water rising in a capillary tube, or of mercury collecting in globules. There are some experiments known to chemists, such as those of letting alcohol fall drop by drop on water, which show the remarkable general loss of cohesion when the surface film is broken and its tension within itself lessened.

The breakage of a gage glass is of exactly the same nature as that performed deliberately when we cut glass to fit a window. The point at which the surface film is broken is far weaker than all other places. If the surface film is broken along a line the glass will break there on very slight provocation.

The supposed breakage of gage glasses "whenever they touch metal" is really only a crude observation; it is almost impossible to let a gage glass come into rubbing contact with any metal object without breaking the surface film at the line or point of contact. For example, it needs only a slight rubbing against the collar into which the glass fits, when the packing is too thin, to have a slight, perhaps invisible scratch. The scratch gives a line of weakness, and the heavy stresses caused by steam pressure finish the job.

A curious related case of the opposite is the foaming produced when we boil soapy water. The surface tension of this solution with solid matter suspended in it also is so great that the bubbles do not escape. In the same way the surface tension of a solution of syrup is great, and thus the carbon dioxide forms a froth when a glass of soda is made up at the soda fountain. (So was it also with the suds on beer in days long dead.)

Athens, W. Va. S. G. RICH.

The Phenomenon of Drift in the Projectile

To the Editor of the SCIENTIFIC AMERICAN:

The explanation of the phenomenon of drift during the flight of a whirling projectile, which I offered in a short article entitled "The Wandering Rifle Bullet," and which appeared in the April issue of the SCIENTIFIC AMERICAN has brought about a controversy.

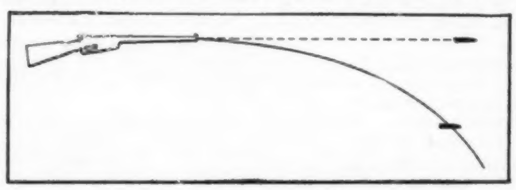
In the article in question the statement was made that drift was caused by the rapidly revolving projectile rolling to the right on a cushion of slightly compressed air caused by its fall toward the earth. This explanation is one which was officially issued to the non-commissioned officers of a certain infantry unit of the National Guard. It also coincides with the explanation which is given by F. W. Mann in "The Bullet's Flight from Powder to Target." It has been used in some of the British army textbooks.

It now appears that this explanation is out of date and in error.

In attempting to locate an authoritative source of information about drift, inquiry was made of Colonel William H. Tschappat of the Ordnance Dept., U. S. Army, in command at the Aberdeen Proving Ground, Maryland, who is considered an authority on ballistics.

In reply to an inquiry, this officer replied: "I am not surprised that your contributor was led to give the explanation of drift which was published in the SCIENTIFIC AMERICAN. At first sight this explanation looks very plausible and it has actually been used in some official textbooks, not, I think, with the understanding that it was the true explanation of drift, but with a view to giving the student some idea of the forces which carry the projectile to the right. The gyroscopic motion of the projectile undoubtedly forms the basis of the true explanation."

This gyroscopic motion or precession is brought about by a force tending to lift the nose of the bullet. How this force comes to bear is shown in the sketch. If the bullet did not fall due to gravity, that is, if it had a perfectly flat trajectory, its axis of revolution would always coincide with the trajectory. But as the bullet falls toward the earth the axis tends to remain parallel with the bore of the gun or rifle. Before it has gone far the air resistance sets up a force which tries to lift its nose. How the lifting force brings about a precession and drift to the right is best made evident by a simple experiment with a bicycle wheel and its axle.



How the air lifts the nose of the projectile

Hold the opposite ends of the axle in the respective extended hands and have some one spin it toward you. Now a person situated at your left would see it whirling just as the rifleman would see the bullet whirling (if it were visible), that is, toward the right. Lightly lift the right hand, just as the air resistance lifts the nose of the bullet. At once the wheel will tend to precess or turn to the right, that is, toward the body. This accounts for the drift of the bullet to the right, for its axis having swung to the right, air resistance keeps crowding or slewing it to the right.

That this phenomenon is a very pronounced one is shown by the fact that if conditions permit, it will continue in other directions. "When the point of the bullet has moved far enough to the right," says Colonel Tschappat, "the resultant air resistance will be on the left hand side looking from the rear and the gyroscopic action will then tend to cause the point to move downward. In firing guns at very high angles of elevation this movement to the right, then downward may go on sufficiently to cause the point to move entirely around the trajectory, even to such an extent as to make the final drift of the projectile far to the left of the line of fire. Here at the Proving Ground we have watched projectiles fired at low velocities at high angles of elevation, drift toward the right and after passing the summit of the trajectory, come back toward the left, falling further to the left than they ever went to the right of the plane of fire. With normal shapes of projectiles the drift with right-hand twist rifling passes from the right to the left of the line of fire when the angle of elevation is 67 or 68 degrees."

Cranford, N. J. ALBERT G. INGALLS.

Magneto vs. Battery

To the Editor of the SCIENTIFIC AMERICAN:

Your magazine has frequently spoken of the importance of the magneto in automobile design. This section of the country is at present land-poor and crop-poor, and I suppose that all over the country agricultural regions are in more or less the same condition. Here, and presumably elsewhere as well, there are today many cars lying absolutely dead because their owners honestly and actually have not the cash for new batteries; whereas cars with magnetos are invariably in commission.

Wilder, Idaho. H. W. STONE.

The Latest in Newspaper Astronomy

To the Editor of the SCIENTIFIC AMERICAN:

Knowing that you are interested in the answers sometimes given by various journals to questions which are in fact a trifle beyond them, I take the liberty of handing you a clipping from a recent issue of a local evening paper:

"When are two heavenly bodies in conjunction? When one is due north or south of the other."

New York. BAYARD S. LITCHFIELD.

Psychic Research Without the Medium

To the Editor of the SCIENTIFIC AMERICAN:

If your investigating body has not disbanded, may I again call your attention to what seems to me to be a fundamental line of examination: namely, the common phenomena of moving objects by a contact which is apparently insufficient to be caused by muscular action. It is most commonly typified in the moving of tables where three or four or more persons are seated around. The results of investigations thus far made by your committee have cast such serious doubt upon the verity of any form of mediumistic powers in a physical way that it would seem to me all the more important to test out the very simplest of these movements. For this purpose it is not necessary to seek professional mediums. On the contrary I have no doubt that almost any half a dozen persons selected at random could be utilized, and with sufficient scientific equipment and protective measures it would be determined with unerring certainty whether there is a force outside those we know whereby the will of ourselves or others can act upon what has hitherto been conceived to be inert matter.

The action of the brain on living matter (so called) such as our own brains and bodies, seems to be yet a baffling mystery in its processes, but we at least know that it operates through nerve, muscles and the like. This, however, affords no apparent clue to the relation of mind to the movements of a physical object such as a table, chair or stool if it be once assumed that these pass beyond the action of the media used by the mind.

Not only would a thorough exploitation of this problem, if demonstrating existence of a hitherto unknown force by unknown processes, be of great value as a scientific discovery, but it might throw light upon those mysterious mental phenomena which are claimed to exist in the realm of psychology.

I am assuming that in such an investigation checks upon subconscious deception would be used, for in numerous experiments of my own I have found in persons of the highest integrity strong evidence of its presence when the mind beneath the surface is tapped. I earnestly hope that you still may be able and inclined to take up this phase of apparently subnormal physical phenomena in the same exhaustive fashion that you have attacked that of the professional medium.

FRANK T. LLOYD.

Merchantville, N. J.

Recently Patented Inventions

As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each. The official printed copies of patents include complete descriptions and drawings of the inventions disclosed. State the patent number to insure receipt of the desired patent copy.

WHAT IS UNFAIR COMPETITION?

WHILE unfair competition in trade is generally regarded as embraced within the law of trade-marks, the reverse is really true, for the latter is but a part of the more comprehensive field of the law and its broad principles protecting business integrity and preventing dishonest methods of trade competition. As in matters of trade-marks the law of unfair competition seeks not only to protect the interests and rights of the trader himself, but in addition seeks to safeguard the purchasing public against deception. It is a fundamental rule that one dealer has no right to palm off his own goods as those of a rival dealer. The courts have repeatedly defined unfair competition, and of such definitions that voiced by the court in Howard vs. Henriques (3 Sandf. New York 725, 1851) is representative. "He (a competitor in business) must not, by any deceitful or other practice, impose on the public, and he must not by dressing himself in another man's garments, and by assuming another man's name, endeavor to deprive that man of his own individuality and thus despoil him of the gains, to which, by his industry and skill, he is fairly entitled." Unfair competition is rarely a matter of a single element and usually consists in the simulation or imitation of various features, such as dress of merchandise, methods of merchandising, color and arrangement of label, etc., so that the entire assemblage, which in its details may be distinguishably different from that imitated, gives to the purchaser the impression that the merchandise is of origin other than its true origin. Copying or infringement of trade-mark may itself be but one element of a general case of unfair competition.

Pertaining to Aeronautics

AIRSHIP PROPELLER—Of the type including a revolvable frame carrying eccentrically thereon a fractionally rotatable propeller blade. Patent 1493324. E. G. Doland, Starksboro, Vt.

Pertaining to Apparel

GLOVE—Formed as a covering for the finger-tips, to allow the application of pomades or medicaments to nails. Patent 1486006. A. Blom, Sheppargarta 14, Stockholm, Sweden.

UNION SUIT—A bifurcated garment for women's wear, possessing a desirable shape, with ample fullness at the leg parts. Patent 1490034. R. Shaner, c/o Aurora Knitting Mills, Pottstown, Pa.

LACING FASTENER FOR SHOES—Which may be used either as an eyelet for threading the lace through, or as a hook. Patent 1489470. E. S. Thomas, c/o Jamison & Hill, Brighton, Iowa.

BATHING SANDAL—Whereby a satisfactory foot covering, with ample circulation of water and air is provided. Patent 1491,-696. E. A. Guinzburg, 85 5th Ave., New York, N. Y.

HAT-RETAINING DEVICE AND HEAD-SIZE ADJUSTER—For the purpose of varying the size of the head-receiving opening of women's hats. Patent 1493407. A. Wenger, 171 Van Buren St., Brooklyn, N. Y.

GARMENT SUPPORTER—For supporting trousers without the inconvenience of suspenders or belts. Patent 1492872. C. B. Wade, Winchester, Idaho.

Chemical Processes

PROCESS OF PREPARING ETHYLENE FORMOCHLORHYDRIN—Whereby a new compound ethyl formochlorhydrin is formed. Patent 1488571. F. Von Bichowsky, 1412 So. San Francisco Blvd., Glendale, Cal.

NON-EXPLOSIVE, MASS-SUPPLYING, HIGH-TENSIONED GASES FROM COMBUSTION—Produced under high pressure for mechanical uses by the combustion of gunpowder and similar explosives. Patent 1493347. W. Kochmann, c/o F. Warschauer, 111 Gitschiner St., Berlin S.W. 61, Germany.

METHOD FOR PRODUCTION OF CYANOGEN COMPOUNDS—Particularly hydrocyanic acid and the alkali metal cyanides, from furnace products. Patent 1492871. F. von Bichowsky, 1412 San Fernando Blvd., Glendale, Calif.

Electrical Devices

THERAPEUTIC APPARATUS—By means of which an electric current is caused to circulate through a bathing fluid in a tub. Patent 1487837. G. Bueckle, 160 Schermerhorn St., Brooklyn, N. Y.

FUSE PLUG—Which may be renewed when fused without removing the base of the plug from the socket. Patent 1488420. W. Watts, 470 Park Ave., New York, N. Y.

ELECTRICAL TESTING SET—Which is small and portable, capable of use in testing circuits for broken wires, grounds, and faulty insulation. Patent 1489127. M. Kammerhoff, 159 Cleveland St., Orange, N. J.

WIRE CONNECTER—For connecting insulated wires electrically without the necessity for removing the insulation. Patent 1488636. J. A. Geiser, 12 Tiggon Ave., Ferguson, Mo.

CIRCUIT ARRANGEMENT FOR GENERATING PURE CONTINUOUS CURRENTS—Suitable for the operating of microphones, in connection with telephone exchanges. Patent 1490031. K. Schmidt, c/o Dr. F. Warschauer, 111 Gitschiner St., Berlin S. W. 61, Germany.

LIGHTING FIXTURE—Whereby chandeliers or wall brackets may be readily removed from their supporting member. Patent 1490010. T. A. Hoos, Box 30, Columbia City, Ind.

LOUD SPEAKING TELEPHONE RECEIVER—Whereby the volume of sound is increased by reason of the elimination of friction in the parts. Patent 1490853. W. Van B. Roberts, c/o Palmer Physical Laboratory, Princeton, N. J.

HEATING UNIT FOR PIPES—Comprising an incandescent lamp, provided with a closure, for use in alignment with water pipes, to prevent freezing. Patent 1489444. J. E. Kestler, Fountain Inn, S. C.

VARIOCOUPLER—With means whereby the rotor and stator coils in a wireless telephone may be mounted in a durable manner. Patent 1489653. A. E. Alger, 218 Florida Ave., Lorain, Ohio.

VARIABLE INDUCTANCE FOR RADIO APPARATUS—For use with radio sets and adaptable to use as either a variometer or a variocoupler unit. Patent 1490842. S. Molina, 282 Lenox Ave., New York, N. Y.

TERMINAL CONNECTER FOR ELECTRICAL CONDUCTORS—Which can be made of sheet metal cut and formed under a punch-press. Patent 1491838. O. Zimmermann, 4421 Matildg Ave., Bronx, N. Y.

BATTERY CAKE—Complete and ready to generate a current when placed between positive and negative elements. Patent 1492435. W. S. Doe, 403 S. Water St., Kent, Ohio.

LIGHT STAND—Including a lamp and mirrors adapted for shaving and other toilet uses. Patent 1492427. R. N. Cioll, 252 So. Main St., Memphis, Tenn.

ELECTRIC GRID—In which the insulators may be readily removed for the purpose of renewal. Patent 1493386. A. S. Rice, c/o Duparquet, Huot & Monsuse, 110 W. 22d St., New York, N. Y.

DRY-CELL BATTERY—With the active agents kept separated to the time of use, preventing deterioration of the elements. Patent 1493435. H. M. Koretzky and B. H. Teitelbaum, c/o Bright Star Battery Co., 310 Hudson St., New York, N. Y.

MICROPHONE—For telephone stations connected to a line supplied by a central battery. Patent 1493415. O. Angelini, c/o Barzano & Zanardo, 9 Via Due Marcelli, Rome, Italy.

Of Interest to Farmers

LIMB SUPPORT—Adapted to be used in conjunction with a prop for supporting limbs of fruit trees. Patent 1487336. B. H. Kamp, Gen'l. Del., Dinuba, Cal.

SCRAPER ATTACHMENT—Such as are commonly used for levelling agricultural land, excavating ditches and the like. Patent 1488059. N. J. Pritchard, Box 438, Santa Rosa, Cal.

GRAIN BLOWER—Adapted for use with threshing machines, harvester threshers, corn shellers, etc. Patent 1489269. G. E. Miller, Trenton, Neb.

GRAIN-HANDLING APPARATUS—Which effects an even, uniform loading of a grain car, without injury to the grain. Patent 1489850. B. Rogers, Guymon, Okla.

BEEHIVE ENTRANCE—For additional ventilation and constructed to be closed at will should robbers be present during honey flow. Patent 1492429. J. B. Cottam, c/o Balaam & Balaam, 1119 State St., Santa Barbara, Calif.

INSECT TRAP—In the form of a portable receptacle into which boll weevil or other insects may be shaken and destroyed. Patent 1491845. C. C. Christal, Gable, S. C.

POISON APPLICATOR—Whereby calcium arsenate, used for killing or checking boll weevil, may be controlled and uniformly applied. Patent 1491872. J. P. McLaurin, Dillon, S. C.

SEED GATHERER—Which may be attached to a mowing machine for gathering seeds from clover or the like. Patent 1492639. L. B. Kolb, Aberdeen, Mississippi.

Of General Interest

COMBINED CARRYING CASE AND ARTICLE OF FURNITURE—For use in connection with camping trips, forming a storage cabinet, and table when set up. Patent 1487575. A. F. Kanthack, 978 Allen Ave., W. St. Paul, Minn.

SLIDING CASTER—Constructed with a cushioning element in combination with a metal cap. Patent 1487678. C. Gebhard, 43 Riverside Ave., Long Beach, Cal.

BRUSH—Designed for cleaning the bottom and walls of a container in one operation. Patent 1487523. S. L. Apatow, 293 Broadway, New York, N. Y.

APPARATUS FOR THE CLEANING OF CLOTHES AND THE LIKE—By means of which a complete circulation of the washing fluid will at all times be assured. Patent 1487619. C. E. Taylor, Box 272, Delhi, La.

SILENT POLICEMAN—Which is a signal device, more particularly intended for street traffic use. Patent 1487635. J. A. Watts, Lock Box, Milford, Pa.

SCRUBBING DEVICE—To be worn on the hand in the form of a glove or mitten. Patent 1487621. J. Thomas, 210½ Heron St., Aberdeen, Wash.

COMBINED LUNCH BOX AND PORTABLE TABLE—Having knock-down characteristics, and as a unit, may be transported on the running board of an automobile. Patent 1487569. C. I. Huddle, Box 927, Porterville, Cal.

TOILET ARTICLE—For containing two kinds of cosmetics, either in loose, or compact form. Patent 1487576. W. G. Kendall, 118 Market St., Newark, N. J.

CLOTHES WASHING DEVICE—In the form of a waterproof bag in which the clothes may be manipulated to effect a washing. Patent 1488414. J. E. Vail and C. E. Stuber, Garden Grove, Iowa.

VAPOR-BATH CABINET—Constructed in such manner that the patient may recline therein with the head protruding from the cabinet. Patent 1488404. H. M. Monford, Hummelstown, Pa.

MINNOW BUCKET—Which may be floated on a stream and from which minnows may be taken without difficulty. Patent 1488331. G. L. Ferris, Willston, Ohio.

SHOE HOOK—Having no exposed portions which might engage with the wearer's clothing. Patent 1487958. A. E. Lind, 419 E. 2d St., Leadville, Colo.

SCREEN FRAME—Formed with movable sides, and a spring action, for fitting the frame into openings of various sizes. Patent 1487970. F. Mushall, 2827 Elston Ave., Chicago, Ill.

VALVE—Which may be adjusted to direct liquid to one pipe or a pair of pipes simultaneously. Patent 1487921. J. M. Deisch, 360 E. Lincoln St., Nappanee, Ind.

MATCH SAFE—Having compartments and safe storage for live matches, and a receptacle for burnt matches. Patent 1488848. M. E. Tuttle, 2139 Wall St., Butte, Mont.

FLOWER HOLDER—For securely holding a flower attached to a lady's waist or the lapel of a man's coat. Patent 1489140. E. D. Miner, American Hotel, Portland, Ore.

FUMIGATOR—Which may be conveniently positioned on a chicken roost or used in like places. Patent 1489071. A. M. Fairfield, St. Marys, Kan.

PUMP OILER—In which, by means of a thumb lever, oil may be pumped with desired force. Patent 1489172. E. R. Symons, Box 257, Roanville, Saskatchewan, Canada.

TAG—Adapted to be removably secured to a phonograph disk record. Patent 1489,-147. G. H. Padgett, Edwards, N. Y.

FOUNTAIN PEN—Of the self-filling type, whereby it is not necessary to remove the nib during the filling operation. Patent 1489186. E. T. Whiffen, 438 So. Columbus Ave., Mt. Vernon, N. Y.

LACE FASTENER—Mounted on the ends of a lace to grip the same, and hold it taut on a shoe. Patent 1489117. J. De Paye, Sayville, N. Y.

MILK BOTTLE SAFE—By means of which a full bottle cannot be obtained unless an empty bottle is placed in the safe. Patent 1489125. L. J. Jaeger, 2315 19th St., Columbus, Neb.

PSYCHROMETER—Which will accurately determine the relative and absolute humidities of the atmosphere and the dew-point. Patent 1488994. A. G. McAdie, Blue Hill Obs., Harvard Univ., Readville, Mass.

WATERPROOF LIQUID WAX—Such as is used in the leather sewing trade for the "waxing" of thread strings, etc. Patent 1488826. E. Pander, San Francisco, Cal.

BRIQUETTE AND PROCESS OF MAKING THE SAME—From lignite or bituminous coal, especially adapted for steamships, railroads, factories, etc. Patent 1488606. G. W. Love, Box 61, Mohrland, Utah.

MOP WRINGER—For wringing and draining the water from a mop, into a bucket. Patent 1489972. H. L. Beaulieu, Box 81, R. F. D. No. 1, Fort Kent, Me.

ARTICLE CASE—With partitions for separating various articles, and especially constructed water-tight joints. Patent 1490001. J. Gaynor, 251 Washington St., Jersey City, N. J.

COMBINED BOTTLE CAP AND REMOVER—In the form of a ring in connection with crown caps, the ring acting as a removal device. Patent 1490022. S. Philippides, c/o V. W. Culting, 25 Broadway, New York, N. Y.

LANDING NET—Which may be collapsed into small space, but when grasped by one hand is instantly ready for landing a fish. Patent 1490048. C. Voelker, c/o A. W. Davis, 1545 Grant Ave., Ogden, Utah.

DRIFT FOR GAUGING AND CLEANING RIFLE AND GUN BARRELS—Comprising a cylindrical metal body, with peripheral cutting edges to travel through the bore of a barrel. Patent 1490038. R. J. Smith, c/o H. R. Cummings, Meikles Gwelo, Ltd., Box 49, Gwelo, South Rhodesia, South Africa.

CAN-CLOSURE CONSTRUCTION—Whereby a sealing device is formed which can be operated in only one manner and cannot be used again. Patent 1490007. C. D. Henriques, 151 Rocking Stone Ave., Larchmont Woods, Larchmont, N. Y.

HAM BOILER—Specially formed for the convenient manipulation of the meat and its removal from the boiler. Patent 1489969. H. Adelmann, c/o Ham Boiler Corp., 1762 Westchester Ave., New York, N. Y.

CHECK HOLDER — Which permits the checks to be easily grasped one at a time for removal from a pad. Patent 1489462. F. W. Schooley, 1031 N. Dearborn St., Chicago, Ill.

CHRISTMAS-TREE ORNAMENT — In the form of a glass bulb, the interior being coated with a material to prevent its easy breakage. Patent 1490320. A. M. Hansen, 21 Penn Ave., Providence, R. I.

SMOKING PIPE—Having a reservoir for collecting all moisture and preventing clogging of the smoke passage. Patent 1490813. V. E. Fermier, Forney, Texas.

DAY BED—Which may be converted either into a settee, chaise longue, or bed, at will. Patent 1490449. H. R. Bensch, 856 No. Flores St., San Antonio, Texas.

ADVERTISING DEVICE—Constituting a bearing for the coil spring of an igniting device and adapted to display advertising matter. Patent 1490262. G. C. Fuller, 13 Green St., Cincinnati, Ohio.

METHOD OF TATTING—By means of implements giving the usual appearance, and new designs to the finished article. Patent 1490,-176. Mary T. Mason and A. M. Calpini, c/o Mrs. M. T. Mason, Riverdale, N. J.

FLASK ATTACHMENT—For securely holding the top of a flask against displacement or loss when unscrewed for pouring. Patent 1490822. S. Haslam, Attleboro, Mass.

METHOD AND APPARATUS FOR TESTING FRICTION BETWEEN SURFACES — At high speeds and under working conditions, for either dry or lubricated surfaces. Patent 1490603. A. J. H. Elverson, The Lynch, Clifton Road, Wimbledon, London, S. W., England.

ROOT FERTILIZER—In the form of a perforated tube, through which nourishment may be conveyed to plant life at the roots. Patent 1490865. F. B. Van de Velde, Box 329, Green Bay, Wis.

KNOB FOR FURNITURE AND THE LIKE—Such as drawers, doors, and other parts, made to be opened by hand. Patent 1490,-854. A. J. Rutter, 1453 Oak Grove Ave., Los Angeles, Cal.

BAIT BOX—With means for preventing the accidental escape of the bait, in removing one or more. Patent 1490868. L. A. Voell, 16 North Main St., Fond Du Lac, Wis.

TOILET ARTICLE ASSEMBLAGE — Comprising a cologne bottle, a receptacle for cosmetic compacts, and puffs, as well as mirrored covers. Patent 1490878. L. C. Wilde, 34 Division Ave., Belleville, N. J.

Hardware and Tools

CURTAIN ROD—Comprising two complementary longitudinal adjustable sections which permit ready access to the casing. Patent 1487017. B. H. Lilja, c/o Davis & Taylor, Attys., Geneseo, Ill.

SHEARS—For pruning shrubbery and the like, and holding the severed end. Patent 1487808. W. T. Rowen, 308 Middlefield Rd., Palo Alto, Cal.

WINDOW TIGHTENER—Which is of spring form, mounted on the frame, forcing the sash against the parting stops. Patent 1488394. H. E. T. Jensen, Dow Ave., Mineola, N. Y.

WRENCH—Of the socket type, which is light in weight, compact, and strong. Patent 1488217. L. A. Prestek, 3420 16th Ave., W. Seattle, Wash.

TONGS—Which facilitate the holding of plow points or like pieces of work. Patent 1489052. M. C. Aldridge, c/o Perkins & Co., Batesville, Miss.

WELL TOOL—Having means whereby the lugs may be readily detached for sharpening or replacing. Patent 1489849. A. S. Riddle, Chickasha, Okla.

COTTON-BALE TIE—Which may be quickly and easily applied without the use of special tools or jigs. Patent 1489427. J. P. and T. C. Cross, Cross Plains, Texas.

KNIFE CONSTRUCTION—Wherein a single handle will alternately receive a knife blade, screw driver, gimlet, or the like. Patent 1489063. W. Carman, 6 Liberty St., Ellenville, N. Y.

POLISHING TOOL—That may be associated with any water supply system and driven thereby. Patent 1489971. H. Bailey, 2307 Morris Ave., Bronx, N. Y.

SHARPENER—Which affords facilities for sharpening chalk, such as tailors use in marking fabric. Patent 1490577. A. Anderson, c/o Wolfe & Schneller, Wahpeton, N. D.

PADLOCK—Adapted for general use, or for railway switch stands, the operating parts being entirely housed. Patent 1490453. Y. G. Caldwell, Paris, Tenn.

CURTAIN ROD—In which the connections will prevent sagging and longitudinal distortion of the rod. Patent 1490824. S. M. Hauser, 131 17th St., Elmhurst, N. Y.

TOOL—Particularly for mounting pneumatic tires of the clincher type on wheel rims. Patent 1491479. G. O. Holben, Housensack, Pa.

PISTON-GROOVE TOOL—Whereby grooves may be quickly cleaned, enlarged or deepened without a lathe. Patent 1491847. R. C. Creed, c/o The Speedy Tool Co., Virginia, Ill.

MILLING CUTTER—Employed for the cutting of profiles, such as gear teeth and the like. Patent 1492505. C. Bonnaffous and P. Bozonnet, 36 Rue Blangui, St. Ouen, France.

INSERTABLE JOINT—The inventor has been granted five patents of a similar nature, providing insertable pipe joints for soil pipes and the like. Patents 1492519, 1492520, 1492521, 1492522 and 1492523. J. J. Meyer, 366 Lenox Ave., New York, N. Y.

PIPE-GRIPPING DEVICE—Whereby pipes of many sizes can be gripped by a simple manipulation of the tool. Patent 1492466. A. Jarmolowsky, c/o "A. J." Nipple & Pipe Cutting Co., 171 Mercer St., New York, N. Y.

Heating and Lighting

FURNACE—In which the air drawn over the fuel bed may be previously heated, thus increasing combustion. Patent 1489853. J. F. Schlappi, 2300 Pierce St., Sioux City, Iowa.

OIL BURNER—Which operates noiselessly and is adapted to heat a furnace. Patent 1489456. J. E. Pearson, 257 E. Delaware Place, Chicago, Ill.

SMELTING ORES—Whereby the use of coke or other carbonaceous fuel is reduced to a minimum. Patent 1490012. A. Kapteyn, Bellerose, L. I., N. Y.

HEAT INSULATING MATERIAL AND PROCESS OF PRODUCING THE SAME—Formed from the leaves and stems of the Typha pressed together in layers or sheets. Patent 1491725. J. G. Needham and P. W. Claasseen, c/o Prof. J. G. Needham, Cornell University, Ithaca, N. Y.

HEAT REGISTER—For uniformly discharging the heat from a so-called pipeless furnace, and preventing floor draft. Patent 1491469. J. B. Driscoll, 802 Rivermont Ave., Lynchburg, Va.

Machines and Mechanical Devices

PICKER MOTION—Including a picker staff, for use in connection with looms. Patent 1487581. A. H. Landry, Townsend, Mass.

VALVE—Of the float valve type adapted for use with tanks or the like. Patent 1487477. L. P. Ross, 156 San Jose, Costa Rica, C. A.

POTATO-CUTTING MACHINE—Which will automatically cut a potato into two, four, six, eight or twelve practically equal parts. Patent 1487905. W. L. Walton, c/o Farmers Supply Co., Bantry, N. D.

PROCESS AND MEANS OF COOLING KILNS—That may be used in connection with the ordinary charcoal kiln without necessitating change. Patent 1487908. T. C. Albin, 241 Arbutus Ave., Manistique, Mich.

MAIL MARKING MACHINE—For feeding, positioning, and spacing the articles, and canceling the stamps, at a predetermined time. Patent 1488424. O. D. Willis, 633 14th St., Huntington, W. Va.

PLUG RETAINER—Adapted for holding a plug against accidental displacement within lubricant receptacles, or other tubular bodies. Patent 1488393. F. W. Jackson, Box 146, Needles, Cal.

DRAG-LINE-BUCKET CLEANER — Whereby the dirt is automatically removed from the rear portion of a drag line bucket. Patent 1487910. E. L. Bartmess, Hillview, Ill.

PRINTING MACHINE — For printing commercially photographic prints from film negatives. Patent 1488555. P. E. Ridings, Tarkio, Mont.

BLOCK MOLD—So constructed that the members may be quickly assembled for use in making concrete blocks. Patent 1489070. G. Ey, 307 E. 87th St., New York, N. Y.

COMPRESSOR FOR REFRIGERATING APPARATUS—Which is simple, compact and composed of few parts. Patent 1489143. W. Nuss, 336 Bloomfield St., Hoboken, N. J.

BUILDING FORM FOR CONCRETE STRUCTURES AND THE LIKE—In which the material can be used over and over again for the same purpose. Patent 1489074. E. Flagg, 11 E. 40th St., New York, N. Y.

DERRICK—Having relatively great strength and constructed of standardized parts, forming the supporting frames. Patent 1489068. C. Drake, Box 82, Mannington, W. Va.

GASKET AND METHOD OF MAKING SAME—Constructed from a single strip of material of superposed plies. Patent 1489184. L. B. Welch, c/o Harry Greeblat, 1771 Woolworth Bldg., New York, N. Y.

HEEL-SEAT ATTACHMENT FOR STAPLING MACHINES—The use of which enables the driving of staples around the heel seat of a shoe. Patent 1489966. A. H. Prenzel, Halifax, Pa.

PLACER-MINING CLASSIFIER—Which functions in such manner as to permit exceedingly rapid, and economical gold separation. Patent 1489975. C. G. Bluhm, Pr. V. D. B., Fruita, Colo.

METHOD AND APPARATUS FOR MAKING CONCRETE BLOCKS—And permitting a facing being applied to the surfaces of block, during its construction. Patent 1489979. T. J. Cahill, 1129 Mt. Vernon St., Philadelphia, Pa.

DEVICE FOR PRODUCING AND DISPENSING LATHER—For shaving purposes in a sanitary form for use in public barber shops. Patent 1489999. F. P. Gallipoli, 1022 Old King's Bridge Rd., New York, N. Y.

FERROTYPE-PRINT-DRYING MACHINE—Supporting the prints in such manner that all portions are subjected to the drying force. Patent 1490519. F. L. Smith, 201 Texas St., at Mesa, El Paso, Texas.

VENEER AND ROTARY CUT LUMBER STACKER—The inventor has been granted two patents, the first for stacking veneer, box shooks and other cut lumber, the second for elevating and separating such dried lumber. Patents 1490594 and 1490595. A. J. De Lateur, c/o J. I. O'Phelan, Atty., Nixon Bldg., Raymond, Wash.

WARP-BEAM LOCK—Or retaining means for preventing a beam from jumping or rising from its support. Patent 1490810. J. T. Emerson, Box 291, Alexander City, Ala.

PLURAL LIQUID-DISTRIBUTING SYSTEM—By which a simple pump may be used to draw liquid from any one of a plurality of sources, without mixing the liquids. Patent 1490179. D. S. Morrow, Milan, Ohio.

WEIGHT-CHANGING DEVICE FOR TOP-ROLL SADDLE MECHANISM—Which can be varied quickly for spinning frames. Patent 1490,-851. C. T. Reid, c/o H. B. Stairley, 72½ Sujemore St., Greenville, S. C.

PICKLING APPARATUS—Including an endless flexible carrier, by which the pickling of tinned plate may be carried out. Patent 1490515. F. D. Kulczycke, 292 Return St., Woodlawn, Pa.

OIL DISPENSER—The inventor has been granted two patents for devices used in dispensing oil at garages, the first delivering by gravity, the second by pump, both indicating the amount dispensed. Patents 1490133 and 1490134. A. J. Simmons, 231 W. Shipp St., Louisville, Ky.

GRASS CATCHER FOR LAWN MOWERS—The receptacle for containing the grass being bodily removable. Patent 1490857. H. A. Schilling, 10454 114th St., Richmond Hill, N. Y.

JACK SPOOL AND FASTENER THEREFOR—Which will not become loose during the operation of the spool. Patent 1490864. H. O. Taft, c/o Vermont Spool and Bobbin Co., Burlington, Vt.

MECHANICAL FOUNTAIN — Operated to throw a jet of water, by means of a plurality of tanks rotatably mounted. Patent 1490,-833. W. F. Kling, 1931 Greene Ave., Brooklyn, N. Y.

PRINTERS' QUOIN—With elements, which, after adjustment, may be locked. Patent 1490807. G. Duncanson, Jr., 97 Randolph Ave., Jersey City, N. J.

MOLD FOR CASTING RIBBED STEREOPLATES—So shaped that the cooling surface is much increased. Patent 1490879. C. Winkler, c/o Winkler, Foller & Co., Berne, Switzerland.

CONCRETE BLOCK MACHINE—By means of which the output is greatly increased, and various sizes of blocks produced. Patent 1491503. F. M. White, 7247 Grand Ave., Chicago, Ill.

SELF-OPENING COVER FOR PHONOGRAPHS OR THE LIKE—Which is adapted to open when a push button is pressed. Patent 1491222. H. A. Arnold, Lenora, Kan.

PROCESS OF PRODUCING SOUND RECORDS—On celluloid films, as for instance moving picture films, so that talking pictures can be produced. Patent 1491256. A. J. Cawley, 3502 N. Broad St., Philadelphia, Pa.

METHOD OF CASTING — Which automatically maintains a constant range of temperature for the mold. Patent 1491173. H. A. Schwartz, c/o H. Kettenring, 607 Bolton Sq. Hotel, Cleveland, Ohio.

COMBINED WIRE STRETCHING AND SPLICING APPARATUS—By means of which two lengths of wire may be spliced and maintained at desired tension. Patent 1491684. D. L. Duden and E. S. Teal, Centertown, Missouri.

TENNIS COURT MARKER—Which may be used in marking hard or grass courts, or other flat surfaces. Patent 1491625. K. L. Porter and M. J. Brazil, c/o Alex Taylor & Co., 22 E. 42d St., New York, N. Y.

APPARATUS FOR REMOVING OIL AND SEDIMENT IN BULK FROM SHIPS—Wherein a vacuum, air and steam, are used to draw the oil and sediment to a discharge point. Patent 1491747. S. Guardino, c/o Rinalli & Guardino, foot of Smith St., Brooklyn, N. Y.

BOILER-TUBE SCALER — Constructed to easily remove deleterious material from either the inside or outside thereof. Patent 1491640. S. Sorensen, 1629 Castleton Ave., Port Richmond, N. Y.

SOUND BOX FOR TALKING MACHINES—Which may be readily used with either zig-zag or hill-and-dale records. Patent 1491723. K. Nalbantian, 25 E. Kingsbridge Road, Bronx, N. Y.

METHOD OF STRIPPING OIL SANDS—Where due to the viscous nature of the oil the natural flow has ceased. Patent 1491138. H. W. Hixon, 115 E. 82d St., New York, N. Y.

Medical Devices

DENTAL IMPRESSION TRAY — So constructed that an impression may be conveniently removed from the mouth. Patent 1487392. P. A. Lee, c/o Thighen, Herald & Lee, Ordis Bldg., Shreveport, La.

SLING ATTACHMENT FOR HOSPITAL BEDS—For the purpose of conveniently elevating a patient from the bed, or to a sitting position. Patent 1487150. H. C. Deakins, 1472 Market St. (rear), Chattanooga, Tenn.

BANDAGE—Adaptable for use in connection with the reformation of facial features. Patent 1487628. F. H. Von Hofe, 151 Montrose Ave., So. Orange, N. J.

CAP FOR PROTRUDING EARS—Used by the medical profession for training the growth of a child's ears. Patent 1489145. J. V. O'Keefe, 460 E. 184th St., Bronx, New York.

SANITARY URINE TUBE FOR INFANTS—Which may be readily attached to or removed from the wearer. Patent 1490793. L. G. and Y. E. Ajamian, 224 Weehawken St., West Hoboken, N. J.

DENTAL IMPRESSION TRAY—Capable of adjustment both laterally and longitudinally to mouths of various sizes. Patent 1493417. L. C. Arnett, 219 So. Main St., Clinton, Ind.

Musical Devices

MUSICAL CHART—Whereby beginners can readily learn the position of notes on the staff, and learn to read at sight. Patent 1489066. A. J. Colon, 145 E. 26th St., New York, N. Y.

Prime Movers and Their Accessories

FUEL VAPORIZER FOR INTERNAL-COMBUSTION ENGINES—With means for injecting superheated air and steam into the inlet manifold. Patent 1488054. C. J. Muzzy, c/o Pioneer Auto Shop, Baker, Ore.

PISTON RING—Especially applicable to pistons of internal combustion and high-speed gas engines. Patent 1488052. A. C. McFarlane, P. O. Box 44, Hayward, Cal.

TIMER FOR INTERNAL-COMBUSTION ENGINES—Which provides for internal connection and protection between the contacts and

The Stamp of Our Approval

Talking to Your Prospects!

WHEN Dickens portrayed a character who tried to sell a cargo of red flannel shirts and brass warming pans to the Fiji Islanders the world laughed, because everyone understood the foolish merchandising involved.

But the annals of modern merchandising are speckled with stories of failures, because Dickens' story has gone unheeded and merchants and manufacturers are still trying to sell their products without giving due consideration to their markets.

Excellent goods, carefully thought out advertising plans, competent sales managership can all be made to register failure, if the potentialities of your market have not been probed.

The salesman who made only one sale in two years—he was selling suspension bridges—was in far better shape than the manufacturer who spent his hard earned dollars to advertise a product without checking up on his market's possibility.

The science of modern advertising can be resolved into an axiom —*Tell your selling story to the man who can buy your goods*—for true salesmanship consists not in selling your products, but in creating a consumer's desire to own your product.

What is needed in advertising are more "centers of impact" and less scattering shots. Scattering shots waste ammunition dollars. Bunch your hits! Tell your story to the man who has the money and the disposition to buy—and keep on telling him. Of course there are not as many men who can buy as there are men who cannot buy, so why waste sales argument? Far better to recite your sales story to a hundred thousand men who can buy than to spread advertising before a million who may say "That's a pretty ad."

Index to Advertisements

conductor wires. Patent 1488434. E. F. Pfister, Box 266, Avant, Okla.

GAS MIXER FOR INTERNAL-COMBUSTION ENGINES—For regulating the admission of air by means of a distributor rotated by the suction draft of the motor. Patent 1488417. K. Volz, c/o F. Warschener, Gitschiner Str. 111, Berlin S. W. 61, Germany.

VARIABLE-PITCH FAN—Which may be associated with the cooling system of internal combustion engines of automotive vehicles. Patent 1489841. G. S. MacDonald, c/o Sheriff's Office, Portland, Ore.

HYDROCARBON-OIL BURNER — Constructed for use with a low grade of oil, and produce a substantially perfect combustion. Patent 1490861. D. Smith, c/o Shiffield & Hervey, Newport, R. I.

ENGINE PISTON—Insuring the efficient lubrication of that side of a cylinder receiving the greatest amount of piston thrusts. Patent 1492917. Z. A. Bruegger, 1422 Main St., Boise, Idaho.

OIL BURNER—Wherein either light or heavy oil may be used and properly atomized for complete combustion. Patent 1493328. W. Durfee, c/o Shiffield & Harvey, Newport, R. I.

Railways and Their Accessories

SUSPENSION MEANS FOR RAILROAD BOX CARS—Adapted to permit a slide door to be easily opened and closed, without sticking. Patent 1488378. J. G. Carroll, 608 E. Martin St., Raleigh, N. C.

AUTOMATIC SWITCH-OPERATING DEVICE—Operated on the approach of the train from either direction, or may be manually controlled. Patent 1487968. W. M. Monroe, 701 Oneida St., Joliet, Ill.

SWITCH STAND—Relating more particularly to switch handles which are simple and reliable in operation, and locking means. Patent 1488527. Y. Q. Caldwell, Paris, Tenn.

MEANS FOR DETECTING CRACKS IN AXLES AND CRANK PINS—In the driving wheels of locomotives. Patent 1488982. J. S. Goyne, Hazleton, Pa.

RAIL JOINT—The elements of which may be easily emplaced or removed, and which will maintain the rails in alignment. Patent 1490047. L. Viezzi, c/o J. Stilz, 687 Bergenline Ave., West New York, N. J.

SLEEPING CAR CONSTRUCTION—Whereby the maximum of comfort and economy of space is obtainable. Patent 1489995. E. Flagg, 111 East 40th St., New York, N. Y.

FILLER NECK FOR LOCOMOTIVE ROD CUPS —In the form of an attachment, for permitting a relatively heavy lubricant to be used. Patent 1490848. G. A. Pettit, L. & N. Shops, New Orleans, La.

ANTIFRICTION BEARING — Particularly adapted for use in connection with railway rolling stock. Patent 1490804. E. Dessauer, West Chester, Pa.

RAILROAD CROSSING—So constructed that the bed is prevented from jumping movements. Patent 1493406. W. V. Van Doren and P. O. Heitmann, 8 Middlefield Road, Burlingame, Calif.

RAILROAD-TIE-SPACING JACK—Which may be easily clamped upon a rail to operate upon two ties with one setting. Patent 1492634. H. L. Hillard, Reiford, Fla.

Pertaining to Recreation

TOY GUN—In which a spring actuated plunger effects the ejection of the missile. Patent 1488995. E. P. McCollom, Box 263, Baltimore, Md.

SHOOTING GALLERY—For use in pleasure resorts, exhibition grounds, or other places, and arranged for a number of contestants. Patent 1489191. F. R. Chester, c/o Chester-Pollard Amusement Co., 1416 Broadway, New York, N. Y.

BASEBALL GLOVE—Of the class known as fielders' gloves, constructed to prevent the fingers being bent back. Patent 1490174. P. Kennedy, c/o Ken-Wel Sporting Goods Co., Gloversville, N. Y.

METHOD OF AND TOY DEVICE FOR PROJECTING SHADOW PICTURES—Very accurately simulating the subject projected. Patent 1490815. T. Fleming, 45 Mechanics St., Newark, N. J.

TOY—In which a small wheel or blade is caused to rotate in one of two directions at will. Patent 1492074. C. H. Dayton, Newman, Ill.

TOY FOR CONTAINERS—Simulating toy furniture when assembled, but originally constructed to hold candy or the like. Patent 1492057. A. F. Wegener, Linwood Ave., Ridgewood, N. J.

Pertaining to Vehicles

DUSTGUARD CASE FOR AUTOMOBILES—Adapted for use in connection with the floor boards through which the operating levers or pedals extend. Patent 1487009. A. H. Blum and D. T. Shanahan, c/o J. S. Hafter, Atty., Greenville, Miss.

COMBINATION RECEPTACLE—Positioned on the dash of a vehicle for the purpose of receiving smoking requisites. Patent 1487574. W. S. Jordan, 2605 Randolph St., Lincoln, Neb.

AUTOMOBILE LOCK—Designed for use in connection with levers to prevent their operation. Patent 1487603. J. Ratto, 29 Alabama Ave., Brooklyn, N. Y.

SHOCK ABSORBER—Of the air cushion type, for use in combination with spring suspensions of vehicles. Patent 1487777. R. M. Gruss, Cadillac Hotel, San Francisco, Cal.

HANDWHEEL—Formed with grooved finger grips, which relieve the user from the necessity of grasping the rim firmly. Patent 1488323. H. W. Dover, Holyrood, St. James, Northampton, England.

FUNNEL—Especially designed for use in the filling of gasoline tanks in automobiles. Patent 1488377. M. Carrau, 510 W. Green St., Urbana, Ill.

ILLUMINATING DEVICE FOR MOTOMETERS —For efficiently illuminating the thermometer, that it may be easily read at night. Patent 1488454. C. E. White, 38 Garter St., Elmhurst, L. I., N. Y.

EMERGENCY BRAKE—Which may be operated independently and used as well for a non-skid device. Patent 1488333. D. E. Force and M. F. Quinte, c/o M. F. Quinte, 312 N. Magnolia Ave., Burbank, Cal.

ICE HOLDER—Adapted for use on the running board of an automobile without injury. Patent 1488181. C. W. Waller, 815 12th St., Portsmouth, Ohio.

DIRECTION-SIGNALING APPARATUS FOR MOTOR VEHICLES — So constructed that it may be actuated by the feet of the driver. Patent 1488033. H. G. Clifton, Berni Apts., Miami, Fla.

VEHICLE WHEEL RIM—Constructed to prevent any corrosion from coming in contact with the inner tube of the tire. Patent 1489142. C. F. A. Nuebling, Broadway, Hewlett, L. I., N. Y.

AIR PUMP—In which difficulties incident to valve mechanism will be eliminated, resulting in a full compression value of the stroke. Patent 1489152. J. P. Quinn, 157 St. Ann's Ave., Bronx, N. Y.

TIRE CHAIN HOOK—Which may be readily applied, and is effective to tighten and secure tire chains of conventional type. Patent 1489067. G. B. Criswell, Savannah, Mo.

CARRYALL FOR MOTOR VEHICLES—Adapted to be extended for carrying packages of any kind, and attached to any suitable position on the vehicle. Patent 1489527. W. Henry, 503 E. State St., Rockford, Ill.

AUTOMOBILE HEADLIGHT CONSTRUCTION—Which permits of a downward deflection of the light by manipulating a switch at the steering wheel. Patent 1490054. O. D. Willis, 633 14th St., Huntington, W. Va.

METAL TOP FASTENER—Readily secured to the front end of an automobile top, whereby the top may be held in adjusted position. Patent 1489465. C. W. Spaugh, 8522 Cameron, Detroit, Mich.

Designs

DESIGN FOR A TEXTILE FABRIC—Patent 63992. Matilee I. Bixby, c/o M. Lowenstein & Sons, 40 W. 23d St., New York, N. Y.

DESIGN FOR TEXTILE FABRIC—Patent 64,-019. C. E. Lord, 25 Madison Ave., New York, N. Y.

DESIGN FOR A LIGHTING FIXTURE TASSEL —Patent 64024. J. Miller, c/o Miller Brass Fitting Co., 33-37 Bleecker St., New York, N. Y.

DESIGN FOR A DRINK-MIXING RECEPTACLE —Patent 64091. M. Weintraub, c/o Weintraub Silver Co., 206 Lafayette St., New York, N. Y.

DESIGN FOR A METAL BORDER STRIP FOR A TRAY OR SIMILAR ARTICLE—Patent 64041. A. Barchoff, 467 Greenwich St., New York, N. Y.

Automobile Identification—a New Book on a New Subject

EVERYBODY knows a Tin Lizzie when he sees one, and doubtless most of us can identify several of the other prominent makes of automobile without actually reading the nameplate. But the person who can name car after car, seen only from the side or rear, or from too great a distance in front to make the trademark legible, always commands the admiration of his friends.

It is very impressive to be able to name all the cars in a crowd, but it is not as a mere exhibition of knowledge that this ability is of greatest value. The person, whether policeman or layman, who is able to state the make and model of a passing car from a glance at the gas-tank filler, the headlamps, or the mudguards, is a mighty valuable member of the community; his knowledge may be the means of preventing thefts of cars, catching reckless drivers, identifying a gang of bank-robbers, or almost any other service to the cause of law and order.

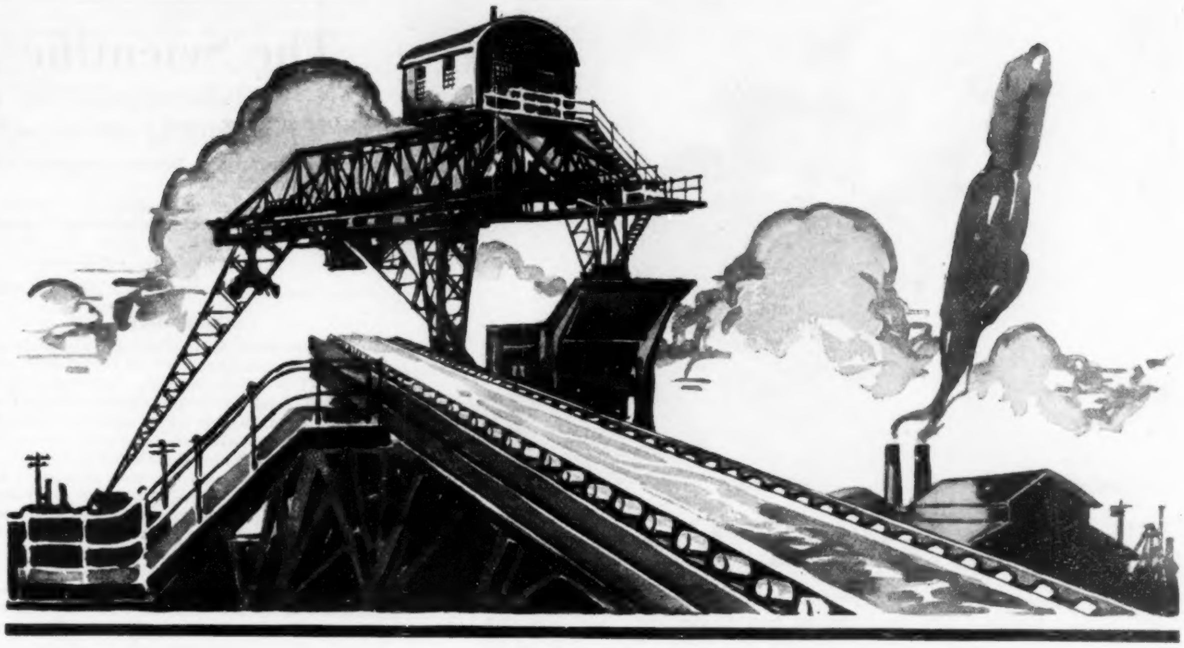
Sergeant John F. Brennan, of the New York Police Department, has more than once earned official commendation and financial reward for his clever work in this field. An example of his work is the location of a car that had smashed a horse-buggy and driven off without being seen. Small fragments left behind enabled him to decide that the car in question had eight-inch headlights of a certain type, six-inch side lights of another specific type, and four-inch tires. This was sufficient to enable him to know the make of the guilty car, and the year followed from other details. An indictment for manslaughter resulted. This case is far from unique; any car whatever can be named as to make and year from surprisingly small data, if one but knows the combinations.

Sergeant Brennan probably is the keenest student of automobile identification in the country today. He has just written a book under the above title. The collateral material on the title page informs us that the Sergeant is Instructor in Automobile Identification in the police schools of New York, and that the book embodies the methods of identification used by him since 1916 and regularly taught in his classes. The book is to be used as a text book in police instruction; it makes equally available to the general public the means of identification of automobiles. This is valuable both for one's personal interest and protection in the event of accident, and for the stimulation of the efforts of good citizens to aid the police in cases where the identification of an escaping car is important. The book is published by the Scientific American Publishing Co., with the permission of the New York Chief of Police, and should be in the hands of every motorist, at least.

Angelique vs. Greenheart

OUR June issue contained an article, "Marine Borers," which told of the failure of greenheart wood in the lock gates of the Panama Canal on the Pacific side; and in the November number was an account of a new wood, angelique, which states that this wood is superior to greenheart in resisting the attack of teredos. Angelique is a product of Dutch and greenheart of British Guiana; and the colonial authorities of the latter suggest to us that we have been victimized by propaganda.

It is not claimed that Demarara greenheart is absolutely immune to the ravages of teredo; but it *is* claimed that no other wood has behind it the same record of durability in harbors and docks all over the world. Numerous quotations from good authorities are given in behalf of this claim, and a number of specific records of performance cited, in which the greenheart has stood up for various periods up to 85 years, and in some of which it enjoys favorable specific comparison with the record of Surinam woods (but not apparently, with that of angelique). A point which is brought out is that in both the Saramacca Canal in Surinam and the Panama Canal locks, the borer which destroyed the greenheart was found to be a new species—in one case Neoteredo Reynei and in the other Bankia Zetekii. Both these live in brackish or fresh water, rather than in the salt water which harbors the ordinary teredo and in which Demerara greenheart has made its fine records. The Georgetown authorities say that while it may be true that the angelique wood will resist the specific varieties of borer which have been destructive to greenheart in the two cases cited, there is no proof at all that it will resist the older forms.



The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals. Other digests appear elsewhere in this issue

Automotive

A New Method of testing body finishes is fully described in *Auto. Ind.* (50:9, 4 pp., ill.). Upholstery fabrics, top materials, body finishes, the color characteristics and durability of which have been unknown or doubtful quantities since the beginning of the industry are approaching the point where their properties may be anticipated in the same manner as those of various other materials that enter into automotive construction. The time element, which has been the chief disadvantage of outdoor exposure tests of these body materials, is being reduced to a period comparable to an engine breakdown test by the utilization of the quartz-tube mercury vapor lamp, which emits ultra-violet rays. These rays, which are just outside the upper end of the visible spectrum of sunlight, are highly actinic and have been responsible for the downfall of innumerable color schemes. As the wave lengths decrease, the actinic action or ability to fade and discolor, due to radiant chemical and physical propensities, increases. This peculiar action tends to harden top materials, causing them to crack and leak. Pigments, the coloring matter in paint, are affected and fade, while the oils in both imperfect varnish and paint finishes are partially decomposed and turn gray or brittle. Body fabrics not only fade but become brittle and weak. Water in the form of moisture or dew is particularly active in conjunction with these actinic rays and hastens all forms of deterioration.

Fakes.—Investigation of a certain chemical compound, the spraying of which in garages was claimed to reduce the danger of carbon monoxide poisoning from exhaust automobile gases, made at the experiment station of the Bureau of Mines in Pittsburgh, fails to substantiate the claims of the manufacturers. Instructions were given to "spray the compound regularly about the work-rooms, wash-rooms, lockers, toilets or where danger from carbon gases exists and watch the results." It was claimed that use of the compound would bring about increased activity among employees, prevent headaches and promote greater efficiency and general improvement in many ways. The compound was "guaranteed under the United States Federal laws." In order to test the merits of the compound some of the product was obtained by the Bureau of Mines and analyzed for its power to absorb, oxidize or destroy carbon monoxide. No indication was found, however, of a decrease in the carbon monoxide content or a perceptible increase in the amount of oxygen through the agency of the compound solution. The compound does not absorb carbon monoxide from garage atmospheres, consequently the spraying of this solution around garages does not decrease the hazard or danger of poisoning from the inhalation of exhaust gases from automobiles. Details of these tests are given in Serial 2594, by A. C. Fieldner and W. P. Yant, copies of which may be obtained from the Department of the Interior, Bureau of Mines, Washington, D. C.

The Self-lubricating Bearing Metal which has recently been developed and put into production by research engineers of a large motor corporation has attracted widespread attention. There have been rumors concerning it drifting about for over a year. Durex bearing material is an absorbent copper-tin-graphite bronze. The graphite exists in a finely divided state, evenly distributed throughout the bronze and interlocked between the crystals. The absorbent qualities of the material are due to the capillary action of myriads of tiny pores distributed throughout its mass. The metallic part is composed of the alpha crystals of copper-tin solid solution, such as make up the matrix of ordinary bearing bronzes. Durex is self-lubricating to the extent that it holds within its walls up to one-fourth of its own volume of lubricating material, which latter can be removed only by special methods. The oil within the bushing walls maintains an oily bushing surface. It may be wiped off, but the surface rapidly becomes oily again. This ability to replenish oil to the bearing surface insures the bearing against running dry.—*Auto. Ind.*, 50:20, 3 pp., ill.

Will an Airplane Float?—Apart from reliability of engines and the ability to alight slowly, it is essential that every passenger-carrying airplane should be able to alight in water and remain afloat for many hours. There will be many occasions on which an alighting in a river or lake in mountainous or thickly afforested country will save the lives of those on board an airplane. The experiment recently made by the British air ministry at Felixstowe showed that the airplane of today is an unsafe vehicle to fly over water of such extent that it is impossible to reach a suitable landing place if the engine stops while over the water. The machine used was an old De Haviland 18 with a Napier Lion engine and carried ballast to represent an average load of passengers. The pilot made what would have been a good "three-point landing" on solid ground. On striking the water the undercarriage set up a drag which threw the machine onto its nose in what looked like a straight dive. The lower planes were entirely submerged and the upper planes went under water up to the rear spars. In a moment or two the machine emerged somewhat ("bobbed up like a cork," as an onlooker said), and settled with the leading edge of the upper plane under the water and the trailing edge of the lower planes above the water and the fuselage at an angle of about 45 degrees. As the machine plunged, the pilot was nearly thrown over the edge of the cockpit. In this case Mr. Rea waited until the machine had adjusted itself before he left the cockpit, and put into it some ballast brought out by a motor-boat to replace his weight. The machine then settled down with the fuselage at an angle of 30 degrees, possibly owing to the air escaping from the trailing edge of the lower planes. The engine was, naturally, completely under water. For some fifteen minutes there was no marked tendency to sink, but thereafter the loss of buoyancy was noticeable, and after twenty-five minutes the water was in the pilot's cockpit. The nose of the machine touched bottom in about thirty minutes after the alighting, but apart from that it was clear that so far as the particular machine was concerned it would not have been safe to trust it to float for more than half an hour.—*The Aeroplane.*

Balloon Tires.—There appears to be considerable concern among some automobile manufacturers and dealers over the unexpectedly sudden and large demand by the public for balloon tires this season. Where the shoe pinches is in the fact that the large volume of this demand could not be foreseen and provided for last summer, and that, as a consequence, most cars were designed for the former standard wheel and tire equipment, and the wheels, rims and tires ordered. Steering gears, fenders, springs and other parts had all been designed for the usual high-pressure tires, and speedometer-odometer instruments were geared for them. Even more important, engine speeds and gear ratios were calculated on the basis of standard wheels and tires, and the weight and strength of all chassis parts were based on inflation pressures of forty to seventy pounds. Car dealers throughout the country have already been stocked with new cars in anticipation of big spring sales, but, unfortunately for dealer and manufacturer, a considerable percentage of prospective buyers are asking for balloon tires. Reports indicate that the cars furnished with balloon tires as standard equipment will not nearly supply the demand, and that where balloons are offered as optional equipment the wheel, rim and tire makers will be unable to supply these in sufficient quantities this season.

Even if they can, it means that much of the wheel equipment already shipped to dealers on cars will have to be removed to substitute balloon tires made for 20 and 21-inch wheels and rims, and neither the dealer nor the car manufacturer is willing to absorb such a loss. It is an awkward situation for which the car makers and dealers are disposed to blame the tire companies, holding that the balloon tires should not have been advertised until later in the season—*Ind. Rubber World*, 70:2, 2 pp.

Civil Engineering

The French are infinitely bolder in the use of reinforced concrete than are the engineers in this country, says *Eng. News-Rec.* (92:12, 3 pp., ill.). The longest span concrete arch near Rouen is a fair example. Let any American engineer consider a moment what would happen if he were to submit such a design to a board of consulting engineers—a span of 432 feet carried on two arch ribs averaging 7 feet square and, except near the abutments, of hollow box section with walls from 12 to 24 inches thick. Unfortunately bridge designing of this type is more or less a business secret in France, so the full details of the bridge are not forthcoming; indeed, we were told the other day by an engineer who had worked in the Limousin office that only the designers of this particular bridge were permitted to see the drawings or computations, which were kept locked up from other employees in a private safe. So we do not know what stresses were permitted, or what loads assumed, except as it is noted that the finished bridge deflected only slightly under a moving load quite comparable to the heavy design loads of this country. The thing that is of interest to American engineers is that in France, where certainly they do not have better concrete material than here, and where, if anything, the highest grade of concreting practice is not so well developed as here—whatever may be said of the average practice—they can build and use safely a bridge whose design would cause any bridge engineer in this country to lie awake nights for the rest of his worry-shortened life. The French have also built concrete airship-hangars of bold design.

Seventy-Ton Freight Cars.—Owing to heavier equipment and increased tonnage it seems that in practically all sections of the country some trouble is being experienced with roadbed previously stable. Some of the larger coal roads are now handling cars with an axle load at least approximating that of the locomotives. The principal effect noted has been the deformation of the roadbed or adjacent ground and the development of water pockets in both cuts and fills. This results in irregularities in line and surface of track, with consequent abnormal strains on ties, rails and fastenings. Remedies are suggested by the committee on roadway of the American Railway Engineers' Association as follows: (1) The subgrade should be kept as free from water as possible. In many cases sewer pipe subdrainage has been successful. Intercepting ditches will aid in keeping the water away from the subgrade. (2) Widening the roadbed will insure a better bearing on the ground under the embankments and help to stabilize the fills. It will provide more ditching room in cuts and permit better ballast drainage, also a greater area of saturation for rainfall. (3) Better distribution of the load can be accomplished by increasing the depth and quality of ballast, increasing the number of ties per rail, increasing the weight of rail, and paying more attention to the bolting, surfacing and tamping of tracks.—*Eng. News-Rec.*

Elevations of Precise-level Bench-marks, thought by many to be forever unchanging, are really affected by those processes of nature which raise valleys to plateaus or mountains and bring elevated regions down to or below sea level. But, in general, the geological processes work slowly, in terms of human time, and few would be the changes that might annoy the engineer. There have been changes in elevation as great as forty feet in a vertical direction in restricted areas during a single earthquake, but such incidents are rare and need not be considered by the engineer, except in certain areas in which seismic activity is known to be great. One of those areas is the coastal region of California. The United States Coast and Geodetic Survey will rerun lines of precise leveling there to discover the rates of change in elevation of the earth's surface. Similar tests are planned along the coast of New Jersey, which may be slowly rising or subsiding. Precise-leveling bench-marks were established and their elevations determined

by the Survey in and near Butte, Mont., in 1906. When the leveling was repeated in 1910 it was found that the bench-marks had changed their relative elevations by amounts as great as 0.9 foot. The marks were substantial ones, and were recovered without doubt. It is believed that the movements were due to the settling of the surface caused by mining operations in the vicinity. It is probable that the earth's surface over any district where extensive mining is done will suffer some distortion which will be reflected in slight changes in the elevations of precise-leveling bench-marks.—*Eng. News-Rec.*, 92:18, 2 pp.

Logic Often Misleads.—Practical pile-driving men often say flatly, "The hammer test can't lie." The statement is perfectly true, but, just as is the case with figures, the message, though truthful, is sometimes downright misleading. This was the case with certain test piles recently driven preliminary to the construction of a navy pier. These test piles, driven with a steam hammer having a 5000-pound ram and 36-inch stroke, showed capacities computed by pile formula greatly in excess of those developed by the permanent piles driven later with a steam hammer having a 7500-pound ram and 39-inch stroke. The discrepancy between the results in the two cases was found to be due primarily to the difference in the hammers, as was proved by driving one of the permanent piles with the lighter hammer.—*Eng. News-Rec.*, 92:21, 3 pp.

The World's Greatest Irrigation Project.—The government of India started last October to build a new dam, known as the Lloyd dam, or the Sukkur Barrage, at Bhatghar, thirty-five miles from Poona. When the work is completed, in 1927, it will be the largest irrigation project in the world, providing water for the irrigation of 6,000,000 acres of land, at a total cost, including the dam and canals, of about $50,000,000. The dam or barrage across the Indus River will be over one mile long and will have sixty-six arched openings of sixty feet each provided with control gates. The dam is being constructed of a local limestone. The height of the dam above the lowest foundation will be 185 feet and the height of the water above the sills of the lowest sluices will be 143 feet. This height can be increased to 153 feet by means of gates in the waste weir. The masonry content of the dam will be approximately 800,000 cubic yards. In comparison with the Assuan dam on the Nile, in Egypt, the Lloyd dam falls short of reaching the dimensions of that structure, which has a length of 6,200 feet and a masonry content of about 900,000 cubic yards. The storage capacity of the Lloyd dam will be 551,000 acre-feet as against 1,070,000 acre-feet stored by the Assuan dam. Immediately above the dam large canals will be taken off. The eastern or Nara Canal will be carried through a deep cut nearly double the width of the Suez Canal, to a distant section of the country in the Nara River valley. The northwestern canal will be nearly 100 miles long and will have about 500 branches. This canal will be nearly as wide as the Suez Canal and will irrigate more than 750,000 acres. The Central Rice Canal, which is the second largest, will be half as wide again as the Suez Canal and its discharge will be equal to that of the River Thames. It will be eighty-seven miles long and will have 350 miles of branches. In all, there will be 850 miles of main canals and over 1,200 miles of branches.—*Eng. News-Rec.*, 92:21.

Canadian Road Type Adopted in U. S.—So impressed have been American tourists and highway officials who during the past two years have motored over the Dundas highway, through Cooksville from Toronto to Hamilton, Ontario, with the excellence of this celebrated motor road that they have carried back to their homes stories of its quality and have prevailed upon their highway departments to adopt its type of construction. Numerous American highway engineers, too, have inspected this Canadian road for the purpose of studying the behavior of its pavement and with a view to adopting the type for use in their own localities. The Dundas highway is paved with an asphaltic mixture laid upon the old highway as a foundation. In this way the Ontario officials salvaged the full value of the old road and effected economies that in view of the excellent results obtained from the new pavement have made a most favorable impression upon Americans. The lower course is of asphaltic concrete commonly known as the "black base" type of pavement.—*Canadian Eng.*, 46:18, 1 p.

Electrical

Electrification of American Farms is a problem as foremost in the minds of engineers of today as superpower, but is a thing that will require considerable experimentation and careful study before it becomes feasible and advantageous to both the farmer and the power company, according to William A. Baehr, vice-president and general manager of the Illinois Power and Light Corporation. In the field of electric users, potentially, he is a heavy consumer of electric power. But he and his neighbors are widely separated, especially in the agricultural sections west of the Mississippi River, in the Northwest and the far Southwest, making it expensive to reach him. Long steel tower electric transmission lines are built across country, and to those not familiar with electrical development it seems an easy matter to run a wire off these lines to every farm they happen to cross, to supply the farmer with power. The lines carry a voltage of from 6,600 to 200,000 volts. In the majority of cases it is most impractical and too expensive to tap a line and reduce the voltage to a degree it can be used on a farm. The cost of reducing it would be prohibitive, and in the process of reduction more current would be lost in the transformer than would be used by the farm. The only feasible plan evident so far seems to be in the building of low-voltage lines extended from a transformer substation in a nearby town.

Vienna has undertaken the construction of a hydroelectric plant on the Ybbs River, which by means of a conduit 6.8 miles long, across a big S in the river, will develop a total head of 415 feet. The power so developed will be stepped up to a voltage of 110,000 and transmitted a distance of eighty-four miles to Vienna. Water from the reservoir passes through an intake gate twenty-three feet wide into an open canal 512 feet long, at the end of which it passes into sand-settling basins. After passing through the settling basins the water enters a non-pressure conduit nearly seven miles long. Over six miles of this conduit are in tunnel and the remainder is in side-hill canals or aqueducts. The side-hill canals are covered over to prevent soil being washed into the stream. The first tunnel is 2.2 miles long and, being close to the side of the valley, is worked from both portals and four adits. The lower end of this tunnel, where it comes out into the river valley, is eighty-two feet above the river bottom. Here a siphon 1384 feet long carries the water under the river, railroad and highway to the other side of the valley, where it enters a second tunnel 2.4 miles long. From this tunnel the water passes into a side-hill canal, which is carried over a creek by an aqueduct seventy-eight feet long, then into a third tunnel, which is intersected at one point by a deep canal cut requiring an aqueduct, and then continues in tunnel to the surge basin. At the lower end the penstock is turned through a horizontal angle into the power house, where it serves three Francis spiral turbines, which, at an efficiency of 80 per cent, have a maximum output of 12,300 horsepower. The generators are direct-connected to the wheels and have a total rated output of 50,000 horsepower. Each turbine uses 141 cubic feet per second and makes 600 revolutions per minute. Electrical energy is generated at 5000 volts and stepped up to 110,000 for transmission.—*Eng. News-Rec.*, 92:12, 2 pp., ill.

Contrary to a Widespread Belief, water-power developments cost more per unit of capacity than steam-power plants. The flowage lands, power sites, dams and power houses of water-power plants are considered cheap if they do not cost more than $250 per kilowatt of capacity. Both step-up and step-down substations are needed, and these in each case cost from $7 to $15 a kilowatt, according to the voltage. A transmission line is needed to get the energy to the market, and the cost varies from $7500 a mile for lines of lower voltage to $15,000 or more for high-voltage lines. A 100,000-volt line cannot as a rule be built and fully equipped for less than $9000 a mile. The total cost of the foregoing items for a good-sized water-power plant situated 100 miles from the market is not less than $360 a kilowatt even under favorable conditions. On the basis of a 50 per cent load factor and with about 20 per cent of the energy generated by the auxiliary steam plant, the operating expenses of such water-power development of about 10,000 kilowatt capacity would not amount to less than $19.80 per kilowatt per

year, bringing the total annual cost per kilowatt of both the fixed charges and the operating expenses for placing the current on the local distribution system to about $71.60.—*Power*, 59:21, 2 pp.

In Sweden 40 per cent of the cultivated farm land is within reach of electric transmission lines, so that not only country villages but virtually every farmer and craftsman within this electrified district can obtain electricity. In evenly settled districts economical distribution is obtained by using an intermediate system of feeder lines as follows: From main high-tension substations, 20,000-volt feeders reach out to rural substations systematically scattered throughout the district. From these rural substations energy is distributed at 3000 volts to the individual farms, where it is further stepped down to 220 volts or 380 volts. The farms are rather small, only one in twenty exceeding 225 acres of tilled ground, but these bigger farms aggregate about one-third of the arable land. The average energy consumption is about sixteen kilowatt-hours per acre a year.—*Elec. World*, 83:20, 6 pp., ill.

A New Type of Diesel-electric Locomotive, especially designed for switching service has been tested by the New York Central Railroad. The power-plant equipment consists of a 300-horsepower oil engine directly connected to a 200-kilowatt generator. The motive power consists of four motors, one of which is geared to each of the four axles. The unit has a total weight of sixty tons, all on the drivers. The unusual feature of this design is the use of a direct-current generator supplying current to the motors without intervening accelerating resistance. This is accomplished by using a differential series field on the exciter which automatically reduces the generator voltage with the increase in the amount of current drawn by the motors. The speed of the locomotive, therefore, automatically increases as the load is reduced, corresponding to the rise in impressed voltage. This control completely eliminates the possibility of overloading the generator or motors or of stalling the engine. The control is so arranged that the opening of the throttle by moving the control lever increases the engine speed and at the same time energizes the exciter field, which in turn energizes the generator field. The generator current passes through differentially wound series field to the driving motors, and being opposed to the separately excited field, lowers the generator voltage in proportion to the load. As the locomotive accelerates, the current passing through the differential series field is gradually reduced, the generator voltage automatically increases and speeds up the locomotive. The main excitation of the exciter field is furnished by a storage battery, which also supplies control current and locomotive lights. It is estimated that the engine will deliver to the drawbar 19 per cent of the heat in the fuel, this being in marked contrast to the steam locomotive, which will average 5 to 7 per cent, and is even better than results obtained with electrified roads, where the efficiency is not over 13 per cent. —*Power*.

General

The Central South at last has a real dairy industry. The idea of the value of cows has been successfully gotten over to the farmers of the cotton-growing sections of the South and to business men and all who are interested in the South's agricultural industry, and it is at last appreciated very fully that with the development of diversified farm production and the adding of dairy cows, poultry and hogs, as permanent phases on every farm, undreamed of prosperity will rise, and that the doubts, fears and danger of periods of depression in so far as the farming interest is concerned will disappear, never to return. With the spread of the cotton boll weevil over the cotton regions of the South it became necessary to make some radical changes in the agricultural policy. Various plans of diversification were tried out with a greater or less degree of local success, but the system which has stood the test in every part of the cotton belt where it has been given a fair and adequate trial is the combination of the cow, the hog and the hen, with general farming. The value of creamery butter alone produced in 1923 in the states of Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Florida and Louisiana was considerably more than $25,000,000. The percentage of increase in creamery butter production in these states for 1923 over 1922 ranges from 8 per cent in Virginia and Kentucky to more than 220 per cent in Georgia. This indicates the proportions to which the dairy industry has already grown.—*Mfrs. Rec.*

The New Steel Motorship, "Henry Ford II," marks a new era in shipbuilding on the Great Lakes. This fine ship, which is one of two designed for the iron ore, coal and coke trade of the Great Lakes, was launched at Lorain, Ohio, March 1, and will be the largest powered Diesel-engine plant ever installed in the lakes district, if not the largest single unit ever installed in the United States. Her length is 611 feet. The main propelling unit is an opposed piston oil engine, two-cycle, single acting, solid fuel injection with four power cylinders 23½ inches diameter by 91 inches combined stroke. This ship is the first to be launched on the Great Lakes electrically. A departure from the present method of launching was introduced, namely, launching the ship by means of a switch. The method of accomplishing this was unique, inasmuch as the guillotine of the eighteenth century and the electric motor of the present day were combined. Three guillotines were placed over the releasing ropes at the bow of the ship and three over those at the stern. The knives were weighted and suspended by means of ropes passing over sheaves at the top of the guillotines. These ropes were secured by a bolt attached to connecting rods working upon eccentrics on a shaft common to all three connecting rods. This shaft was rotated through gears by a motor at a speed of sixty revolutions per minute. At this speed it can readily be seen that the motors did not reach their maximum speed before the knives had been released. The starting of the motors was under the control of the sponsor of the ship. —*Iron Trade*, 74:19, 3 pp., ill.

Twice as Much Calcium Arsenate was used for poisoning the boll weevil in 1923 as in 1922, and the sales of calcium arsenate thus far in 1924 indicate that the amount of poison used will again be doubled in a year. The idea there would not be enough arsenic available to supply the cotton farmer to kill boll weevils, to supply the orchardists and truckers for spraying insects, and to take care of the demand of the glass manufacturers and others has been dispelled. The demand uncovered unexpected sources of supply. The increase in the use of calcium arsenate by the cotton farmer will depend upon its price. The great increase this year is in a measure due to a lower price than prevailed in 1923. Now B. R. Coad, chief in charge of boll weevil work of the government, holds out promises of still cheaper calcium arsenate in future years by reason of the discovery of simpler methods of combining arsenous acid and lime, indicating that the price may be lowered to six or seven cents after the promising new discoveries are fully developed.—*Mfrs. Record.*

Humidity Is Worse Than Heat.—That the human body, in a state of rest and in still air, cannot endure indefinitely a temperature higher than 90 degrees Fahrenheit with 100 per cent relative humidity, has been determined by Department of the Interior investigators at the Pittsburgh experiment station of the Bureau of Mines, cooperating with American Society of Heating and Ventilating engineers. In the course of the tests it was noted that the heavier and stouter men of the experiments, when subjected to uncomfortably hot temperatures, lost more weight than the lighter and thinner men, but as a rule could endure such temperatures for a longer period and complained less of the exhaustion which followed. Loss of weight in the subjects experimented with gradually increased with an increase in atmospheric temperature. Whenever the subject drank ice water he immediately gained in weight, and in all cases the subject within twenty-four hours usually regained the entire weight lost. Subjects who drank ice water freely after exposure to high temperatures felt no ill effects, tending to disprove the assumption that such action develops severe cramps. The pulse rate, rather than the rise in body temperature, apparently determines the extent of the discomfort experienced by the subject.

The Ammunition Left by the Germans in northern France and Belgium at the termination of the war has been successfully disposed of. During the last two years some 14,000 tons of German ammunition of a very dangerous character has been brought to the coast and dumped in the ocean about two and a half miles from the shore, without any accident having occurred from explosions, either during the transportation or dumping operations.—*Machinery.*

The "Margery" Mediumship—I

(Continued from page 89)

FH coincided as to their source—the corner in the wall between the victrola and the mantel. Dr. Carrington's line to this point passed approximately through Miller, but he was very positive that the sounds came, not from where Miller could be, but emphatically from a point several feet behind him. From me they were in a direction which intersected no sitter. Indeed, as I stood at the edge of the cabinet wall, I was decidedly on the outer fringe of the circle; and in this position the sounds came to me unmistakably from behind, at an angle off to my right (the medium being at my left, and Miller distinctly not behind me).

FH placed the sounds on another quarter, between the windows, where Chester's previous talk suggested that they would come. They probably fell at equal distances from his two ears, making him unable to locate them at all and reducing him to dependence upon expectation. Or another answer would be that he did them himself and judged it wise to dissent on their location. But I am prepared to insist he didn't do them.

Just as we are about to go to press I learn of a repetition of the independent voice on June 17, in Dr. Comstock's presence. Miller was absent; mouth control was severe all around the circle. The sounds were again whistled and whispered hello's; they were located substantially in the same place as before, and hence again remote from the medium.

Dr. Carrington, by the way, is positive that the difficulty of locating sounds in the dark is exaggerated. The absence of any tendency by our investigators to locate sounds outside the cabinet as a general thing rather bears this out; and if we go so far, it is difficult to avoid going farther.

I am close to Margery, during our seances, more often than any other of our members. My hand control alone would insure this; in addition, Chester often invites me, for my comfort, to sit on the floor in the cabinet while exercising this control. Occasionally I even sit on a chair in the cabinet, bringing my head to a position where I can easily touch hers with mine as a measure of control. Only occasionally does my presence in the cabinet check the vocal phenomena. When it does not, I locate almost all of Chester's whispers and whistles approximately where I should infer Margery's head to be; but a sitting seldom goes by without one or two very clean-cut impressions that I have heard Chester from a point too high or too far back for the easy explanation. So far as they have had opportunities for the observation, my colleagues are inclined to agree with me here.

Now the above aims not at all at a complete statement of all the striking phenomena that have occurred in our presence, but merely at a display of the most striking instance of each type. The entire series of observations chronicled is open to the objection that their significance depends altogether upon one's certainty regarding the control, and upon the adequacy with which one has insured that the premises are not prepared for the performance. It is easier to get personal satisfaction on these points than it is to convince the cautious reader who wasn't there. Nevertheless, we should be prepared to fight it out along these lines, if they seemed the most promising. But they don't.

A fundamental characteristic of the Chester personality is that his attention cannot be held for any prolonged period upon any single type of spontaneous manifestation. Tonight we get a brilliant demonstration with the lights; tomorrow with the pole; next day with the cabinet, or the ukulele, or the table, or the voice. We cannot get promises from Chester on which we can rely; and particularly if we concentrate our expectations on some particular manifestation, we are almost certain to get something else.

This surprise element is rendered doubly unfortunate by the complexity of the seance room. It is quite out of the question to give, every evening, an examination of such thoroughness as to cover all the ground, insuring that whatever might occur we could make the reader feel that the possibilities of fraud *in that direction* had been completely forestalled. The result is that, while at one time or another we have had brilliant performances with the voice, the pole, the lights, the cabinet, the table, all under control that seemed to preclude the possibilities of fraud, these demonstrations have in no case been preceded by an examination of the premises that was pertinent to what Chester actually did.

There are other, and more obvious, disadvantages in the procedure of "sitting around in the dark and getting struck by an illuminated curtain pole," as I have sometimes put it in informal conversation. If all these difficulties were inherent in the mediumship, we should have to seek some way of avoiding them. But experience indicates that, whenever something brand new in the way of apparatus is provided in the seance room, Chester is far more likely to attack it than to avoid it. We are led by this observation to the hope that we may be able to invent something for him to do, on apparatus of our own construction, which will, at one and the same time, solve all our problems.

Such apparatus, with the manifestation which it is designed to provoke, must eliminate in whole or in part the necessity for hand and foot control. It must offer the hope that it may, in whole or in part, be operated in the red light. It must to some extent be capable of self-recording. And it must be independent of the necessity for examination of the premises. The advantages of enabling us to say that the apparatus was ours, and was found, at the end of the crucial demonstration, in exactly the same condition as when we brought it in, are very large and very obvious.

We have experimented a good deal along these lines, and we feel that we have several types of apparatus, all offering promise. Trying these out in the seance room, we find that to a great degree they get away from Chester's penchant for the unexpected. To a much larger extent than with the spontaneous stuff, he shows a tendency to have his attention caught and held by one thing, to stick at this thing night after night, and to do it when he says he is going to do it.

The spontaneous phenomena have been valuable in the insight which they have given us into the mediumship—more valuable, in fact, than it is possible for the present story to make apparent. It looks very much as though we shall ultimately come to an installment of my story in which we shall devote ourselves exclusively to our impressions of the Chester personality, and our conclusions as to just what we may believe regarding this personality. When we get to this, it will become abundantly clear that we have not been pursuing the spontaneous phase of the mediumship up a blind alley. But for the present purposes, we must act as though we had been doing just this. We must tell Chester that we aren't interested in lights, poles, voices, etc., until after he has proved his case in what we regard as acceptable fashion; and that if he wants to do this in a hurry, he would best devote himself to some of the apparatus which we have made for him.

This apparatus is of various sorts. We have provided paraffin for the manufacture of hands of the Kluski type, described in our issue of last November. We have given Chester an opportunity to produce simple mechanical effects inside a sealed glass jar. We have supplied electric contacts of several sorts, the idea being that Chester may close the contact and thereby ring a bell or light a light. We have offered him an ordinary chemical balance, with the suggestion that the manipulation of its weighted pans, in red light and under a cover of some sort, in defiance of the laws of gravity, would constitute a valid demonstration. And always we have kept before him the possibility of giving us in some way, on the photographic plate, either an independent manifestation or evidence of the solidity of some of the phenomenon just catalogued.

The photographs that accompany this article, as well as others to follow, will convey some idea of the extent to which laboratory technique is being brought to bear in harnessing the unusual forces with which we are confronted and then analyzing them.

On everything of the sort which we have supplied, Chester has made a preliminary attack; and there appear to be excellent grounds for hope that, always assuming the mediumship to be genuine, we shall through one or another of these modes of attack get a valid demonstration of genuineness. At the moment of writing he has abandoned all else in favor of the scales, upon which he is concentrating his attention to the exclusion of all other phenomena. The regular sitters feel that, in our absence, Chester has done, for them, within the past week, exactly what we have asked him to do for us; so we wait with somewhat whetted appetites the moment when he does it for us. And at this point I reach the limits of my space, and must in turn abandon the story of Chester's further progress, to be continued, presumably in our next issue, and certainly in an early one.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

The Electrodynamic Type of Loud-Speaker should not be confused with the more common non-power type of loud-speaker. The former has an energized magnetic field, which calls for an additional drain on the A-battery, while the latter operates directly off the output of the receiver, without additional current consumption. However, the electrodynamic type is capable of great volume, especially for dancing. One of the electrodynamic loud-speakers now comes with an adjustable electromagnetic field, so as to regulate the volume. The adjustment is in the form of a resistance connected with the electromagnetic winding of the field. Thus the loud-speaker may be operated without power excitation, or with more and more power excitation until the full electromagnetic field is obtained, which calls for about three-quarter ampere current consumption from the A-battery. As far as tonal qualities are concerned, the writer of these lines finds that the electrodynamic type is deeper, richer and more realistic than the general run of non-power loud-speakers.

Transatlantic Telephone Tests have been conducted for some months past by the American Telephone & Telegraph Company and the Western Electric Company engineers. In fact, rumor has it that commercial conversations may be carried on before the end of the year. For the present, special attention is being paid to modulation and to the development of secrecy. Daily talks with a British receiving station have been carried on from the great transmitting station at Rocky Point, some 70 miles east of New York, on Long Island. Test words and short phrases are repeated hundreds of times by a large staff of engineers and operators, who record their observations for the benefit of the designing engineers. Secrecy, it is reported, will be achieved by "scrambling" the conversation at the transmitting end and "unscrambling" it at the receiving end. In this manner it will be possible to make radio telephone conversations private. There is a very remote chance that some ingenious experimenter may pick up disconnected bits of conversation, but as a general thing the radio telephone user will enjoy the same secrecy as the wire telephone.

The Radio "Knife" for the Surgeon.—Application of radio impulses to a surgeon's knife which burns its way through the tissues of the body, cauterizing as it passes and thus produces nearly bloodless surgery, is claimed by Dr. L. E. Schmidt of Chicago. With the use of the new instrument, two operations for cancer of the bladder have been performed successfully, so it is stated. A low-power radio transmitting set is used to generate the current. The "knife," which is about half the breadth of lead pencil and resembles a knitting needle, forms one terminal. The other is applied to the patient. The human tissue offers resistance to the passage of the current when the knife is applied. The resistance causes heat. The knife burns itself through the skin, fat and muscle quickly and without pressure. The set is equipped with two 50-watt power tubes and condensers. The current oscillates at the rate of 40,000 cycles per second, with a potential of 800 volts and a current output of 450 milli-amperes. The one advantage the radio needle has over the knife is that it prevents loss of blood, unless a large artery should be severed, in which case ligatures should have to be applied. The patient is thus saved the usual shock that follows major operations.

Warm-Weather Radio.—There is no reason why we should not enjoy radio during the summer, but it is useless to expect the same efficiency from our radio receiving set as during the cold, crisp winter weather. Warm weather is accompanied by thunder storms and atmospheric electricity in abundance, which are detrimental to radio communication. Nevertheless, these disturbances are not always such as to prevent good reception of nearby transmitting stations. It is a good plan during warm weather to reduce the size of the antenna. The author of these lines uses an antenna measuring 125 feet long during the fall, winter and spring, and an antenna measuring but 60 feet long and only 12 feet above the ground during the summer. With a long and high antenna, one is bound to pick up a good deal more static than with a short and low antenna. The latter will be found ample for the reception of nearby stations; and since the static will prevent the clear reception of long-distance stations, the radio enthusiast may just as well resign himself to his local programs. Nevertheless, there are some nights during the summer which are remarkably free of static and which permit of long-distance reception. The ideal arrangement, therefore, is to have two antennæ, a short and a long antenna, with a switch for connecting either one with the receiver.

Wired Wireless Broadcasting, as carried on by Wired Radio, Inc., over the electric light and power wires of the Staten Island Edison Company, has been going on for the past two years. The technical work is under the direction of R. D. Duncan, Jr., former assistant to Gen. George O. Squier. The distribution system selected is admirably adapted for experimental work of this nature, as it combines a single and a three-phase feeder distribution at 2300 and 6600 volts. Then, too, it is almost in the shadow of numerous powerful broadcasting stations and is in the path of a vast amount of ship-to-shore radio communication. These conditions have given absolute assurance to the wired wireless engineers that wired radio is proof against interference. Transmission has been successful on both overhead and underground lines, although attenuation of signals is somewhat greater in cables than in aerial conductors. From the program angle, it appears that the subscribers to this wired radio broadcasting service have been dissatisfied with the idea of being limited to a single program. They have had no selection. To solve this drawback, the engineers have been at work on ways and means of multiplexing the wired wireless service, and present indications are that shortly this service will include three programs transmitted simultaneously, with any program tuned in by the present subscriber's receiving apparatus.

Space Radio vs. Wired Radio.—It might be well here to state that wired radio does not look upon itself as a competitor of space or orthodox radio. No method has yet appeared of putting space radio on a paid basis. The space broadcaster renders a free service to his unknown patrons, and cannot afford to buy high-grade talent for programs. Wired radio, on the other hand, is taking the form of a paid service supplied on a rental basis to regular subscribers. Seemingly, there is room for both types of radio to grow side by side, performing their different functions in their respective ways. Because the wired radio plan, fundamentally, provides for paid musicians, paid artists, paid lecturers, and so on, it may be expected that wired radio programs will be far superior to those sent free from the space broadcasting stations. We do not overlook the fact, however, that many interesting programs will always be available to space broadcasting stations on a gratis basis. To the person who owns a vacuum tube space set, equipped with a loud-speaker, the wired radio organization can offer a wired radio tuning unit to be connected to the space radio receiving set. Thus, by throwing a switch, that person can intercept programs transmitted over the lighting wires or programs sent through the air. Furthermore, the wired radio broadcasting station is certain to intercept the best features of space radio and rebroadcast them to its wired radio subscribers.

The Thermoformer is the name given to a new device which enables the radio enthusiast to operate his vacuum tubes on commercial 110-volt A. C. or D. C. supply. It is the invention of R. E. Sabin, a noted chemical engineer of Somerville, N. J., in cooperation with L. G. Pacent, the well-known radio manufacturer and engineer of New York. The thermoformer makes use of the thermo-electric method of energy transfer. The thermo-electric power transformer consists of a number of pairs of dissimilar metals in contact, one junction being in close thermal relationship with, but neutrally

coupled electrically from, a resistor element in the power or light circuit. The difference in temperature between the metal members causes the flow of current, and while the potential of a single thermo-couple is quite low, any desired potential may be obtained by using a battery of bi-metallic units connected in series. Novel adjustments of the electrical resistances, thermal conductivities, emissivities, radiation, etc., of the various parts have been made, all contributory to the final perfected results. The present thermoformer consists of a neat pressed metal container in which are placed the several rows of bi-metallic units, as well as the electrical resistor element. The lighting current is led directly to the resistor element, which operates in much the same manner as the heating element of an electric iron. This heat is brought to bear, without any substantial electrical coupling, on special electrode castings, while the other end of each of these special castings is in contact with a strip of metal which comprises the other member of the thermo-couple. The thermo-couple units are all joined together so that their individual electrical outputs are combined for the desired output. The container is provided with screen top and bottom to permit the passage of air to carry away the undesired heat. The thermoformer can be arranged to operate the filaments of a number of vacuum tubes, which is the more difficult task, as well as the high-voltage "plate" circuits which usually call for "B" batteries. Even the grid-biasing or "C" battery energy can be supplied by the thermoformer. Several demonstrations of this device, both with head-phones and with loud-speakers, have proved conclusively that the results obtained are as clear as a bell, without hum or buzz. The co-inventors of the thermoformer are to be congratulated on this ingenious and promising application of the old thermo-couple method of producing direct current.

Selecting the Loud-Speaker.—In a recent issue of *Wireless Age*, Dr. Alfred N. Goldsmith, Director of Research, Radio Corporation of America, tells of the principal faults of some loud-speakers and the general listening tests for them, as follows: 1. The loud-speaker fails to reproduce high-pitched notes, but does respond to low-pitched ones. Such loud-speakers will sound well on piano pieces in the lower register, and on bass voices. Tenors and sopranos will sound thin and weak, and the violin will lack piquant quality, being "flattened out" into flute quality. Speech, and particularly feminine speech, will not be fully intelligible. Orchestral selections will sound noisy and will have a drumming quality. 2. The loud-speaker fails to reproduce low-pitched notes, but does respond to high-pitched notes. Speech will be fairly intelligible on such loud-speakers, but the piano will sound thin and much like a harp or guitar. Bass voices will be weak or else sound like thin baritones. The effect in the rendition of orchestral selections will be feeble and squeaky, and without "body" or roundness. The accompaniment of the 'cellos and violins, and other deep-voiced instruments, will be lost. The general effect will be that of a cheap and poorly designed portable phonograph with a small horn. 3. The loud-speaker may reproduce only notes in the middle register, dropping out high and low-pitched notes. This is unfortunately a fairly common fault. While speech is moderately intelligible on some examples of this kind of instruments, music is very unmercifully treated and the faults are a combination of those mentioned in 1 and 2 above. 4. Loud-speakers should not rattle on the loudest notes which are produced; but the user should be cautious in drawing conclusions since he may be overloading his vacuum tubes by excessively loud signals, combined with low plate voltage and incorrect grid bias. Unless the listener is sure the vacuum tubes are not themselves being "saturated" or overloaded, he should not blame the loud-speaker for rattling noises. 5. Loud-speakers occasionally are insensitive; that is, they fail to respond to weak signals at all, and do not give a good response to reasonably loud signals. The objection to insensitive loud-speakers is the necessity for overloading the tubes to get loud signals. 6. Some loud-speakers, while otherwise fairly satisfactory, reproduce combinations of instruments—voice and piano, or violin and piano—less satisfactorily than solo efforts. This fault requires for proof of its existence a careful listening test on a suitable selection from a broadcasting station of repeatedly proven high quality.

On the Road

(Continued from page 79)

your time and comprises less than one per cent of your mileage, it will provide at least 50 per cent of your troubles. In the city there are more rules than in the open country; more of them are likely to be unfamiliar to you; your infraction of them is more noticeable; there is greater risk to you and to others when you thus infringe.

What are you going to do about the standing trolley? What are the local speed limits; and are they absolute or discretionary? Are you going to get reprimanded for something that is perfectly regular at home—as I was the other day for moving over upon the trolley track, in the complete absence of cars and safety zones, to get around a truck that was lumbering up the street at eight miles an hour? (If I were to confess that I once got myself all but arrested for driving to the *right* of a traffic post, residents of Philadelphia would perhaps be my only readers to appreciate that I had not committed a misprint.) Are the local police tolerant toward strangers who don't know the local rules, or are they inclined to be nasty about it? What about turning to the left—do you cut the officer short, or drive around him, or wander in a graceful three-quarter circle all over the territory common to the two streets (perhaps you have never been in Columbus, Ohio), or are you forbidden to turn left at all? What happens to you if you strike the wrong combination here, or if you miss a one-way sign that is totally different in size, shape, color and location from those you are used to? Just how serious are the complications and how great the delay and expense if a "foreign" driver gets himself arrested for something that, with a "home" driver, would involve only a summons or a punched ticket?

My own recipe for driving in a strange city is to pick out a home driver—a fairly enterprising one, preferably a taxi-driver—and follow behind him as long as he continues to go my way. Until he is passed through a policed corner and I am held up, or until he turns off my route, I do as he does, and am then fairly safe against anything other than a speed violation. When he loses me or I him, I look for another of the same sort. With this, plus the further precaution of examining the neighborhood for restrictive signs before parking, and placing your car parallel with the others that are parked in adjoining spaces, you are pretty likely to keep out of trouble. My Philadelphia *faux pas*, to which I refer parenthetically in the previous paragraph, arose when I was obliged to lead a traffic wave through an eccentrically governed intersection.

The average driver, however, does a lot more city work than he needs to do. In many cases it isn't to be avoided; through a city of 25 or 50 thousand there is usually only one practicable route. Cities of 100,000 or more, on the other hand, frequently offer sights that you want to see, or give you the first opportunity of a week to put up at a first-class hostelry. But when you are going right past them, as is perhaps more often the case, cities of this size almost always offer an alternative to Main Street and the public square. You won't find it in the text of the Blue Book, because such a city is the meeting point of several routes, and all of them take you down to their common point at the civic center. But the Blue Book does give you a very satisfactory map of the city, and so does the Michelin folder—this is one of the chief reasons why I value these publications above all other commercial maps or route books. Always, if you study this map and the ground before you, you will find a way around the city's congested zone, which will probably lie through better streets than the blazed trail through the business center. If you seek such a bypass and follow it, you will not merely speed your own passage, but you will also contribute to the lightening of the traffic jam for those who must go down into the city.

The larger the city, the more sweeping this bypass will be. In New Haven, Springfield and Worcester, for instance, it lies through paved and built-up streets, in the city proper. In Philadelphia and Boston it goes around a wider sweep, through the fringe of the built-up section. In Chicago it is anywhere you want to put it—close in to the city, or far out. In New York, if you know how to do it, you avoid the city completely, using the Tarrytown ferry, 20 miles up the Hudson River, and cutting New York, Jersey City and Newark out of your route at one blow.

Sometimes this detour is more or less officially recognized. Philadelphia's, for in-stance, is marked with Lincoln Highwa[y] signs, one set of these going down into th[e] city and the alternative set going aroun[d]. Worcester has pretty little arrows indicatin[g] that if you are bound for points beyond th[e] city, this is the way to go; and here as [in] Philadelphia, once you get in the detour yo[u] can't go wrong. The way around Bosto[n] from Waltham to Revere Beach is laid dow[n] for you in the Blue Book.

My own experience indicates that Cleve-land, Buffalo and Pittsburgh are the harde[st] cities thus to cut out. In Cleveland o[ne] must leave the main line and try to pi[ck] out, on the map, a parallel street, furth[er] south, that is not interrupted by Cuyahog[a] Creek or any of the railroads. In Buffal[o] one must leave the main line far outside th[e] city and make a sweeping detour throug[h] East Aurora; and this is hardly availabl[e] if one plans to take in Niagara. It is ver[y] much worth doing otherwise, however, fo[r] the main route through the southern pa[rt] of Buffalo is pretty distressing. Pittsburg[h] with its interminable string of river tow[ns] above and below, and the cliffs behind the[se] is a nut that I have not been able to cra[ck] at all, save by staying off the Pittsburg[h] routes entirely whenever possible.

Traffic in the cities of major rank [is] heavy at all times. Traffic in the territo[ry] surrounding them is at its height on Su[n]days and holidays. If it is at all possib[le] for you to do so, lay out your drivi[ng] schedule so that you shall not come withi[n] 50 miles of any of these cities on a Satu[r]day afternoon, a Sunday, a holiday, or [a] late afternoon preceding a holiday. Th[e] cities to which this caution particularly ap-plies are New York, Chicago, Philadelphi[a], Boston, Cleveland, Pittsburgh, Los Angele[s], San Francisco, Baltimore, Washington, S[t.] Louis and, perhaps worst of all, Detroi[t]. The closeness of New York and Philadelphi[a] makes practically the entire State of Ne[w] Jersey fall in the proscribed area; and the[re] might profitably be included Massachusett[s] east of the Connecticut River, with a[ll] Rhode Island and Connecticut. You to[ur] for pleasure; and you won't get much of [it] in this territory on these days.

Those who are interested in making th[e] trip at low cost will feel practically oblig[ed] to camp out wherever the country is such [as] to permit this. The public camp ground[s] and the private ones where one may loca[te] for a small fee, are sufficiently numero[us] to make it possible to perform almost a[ny] tour without patronizing the hotels a[nd] boarding houses. The major problem of th[e] camping tour is what to take along, and i[n] this connection one of our contemporari[es] recently told a story that will bear rep-etition.

A garage proprietor in the big mountai[ns] of the west was called out in the middle [of] the night to bring in a car with a broke[n] axle. He labored from midnight to da[y]break to get his dolly under it and to g[et] it safely down out of the high places. A[ll] the way in, the proprietor of the wreck w[as] abusing his machine for having gone bad on him without warrant. Arrived in tow[n] the weary garage man took time to tow th[e] crippled car to a big freight scales. H[e] forced the owner to unload all his bagga[ge] on the scale platform, and to get on himse[lf] with all his passengers. The total weig[ht] which the car had been carrying, as thu[s] determined, was 1640 pounds. The gara[ge] man waved an index finger toward the indi-cator and remarked succinctly: "That's wh[y] your axle went out."

The sequel to this tale will also bea[r] narration. His car repaired, the owne[r] sorted over his duds and left about half [of] them behind. On passing through the tow[n] en route home, he was sport enough to con-fess that he had never missed them. I ur[ge] all my readers who are going camping to [do] their sorting before something breaks, rathe[r] than after. Besides useless furniture, th[e] greatest saving will be effected in foodstuff[s]. You are not starting across the Sahar[a] Desert; you don't need to carry more than [a] day's provender at any stage of your cam-paign, and you won't save enough money [to] amount to anything by stocking up o[n] canned goods and making a traveling grocer[y] store of your car.

The party that doesn't plan to camp en-joys one major diversion of touring that [is] denied the camper—that of looking for a ne[w] place to put up every night. At 11 A. M. one passes house after house, inviting i[n] appearance and of charming outlook, wi[th] signs out "Tourists Accommodated." At [4] P. M. the picture changes, and from the[n] till dark the way is lined with squali[d] foreign settlements, burned-over forest lan[d]

coal mines and blast furnaces, noisy amusement parks, fertilizer works, and scrub land with no human habitation save the cabins of the poor white trash or their northern equivalent. Why is this thus?

If the place in which you stop for the evening meal looks like a good one in which to sleep, think carefully before driving on through the evening in the hope of finding another equally attractive. By the same token, if you see a first-class place to eat and sleep as late as six o'clock, give another thought before passing it by. If you don't get fixed by dark, be assured that any place you choose will be poor; you need daylight for a comprehensive search after high-grade lodgings.

Hotels in the cities, from largest down to the bottom of the list, divide cleanly into the modern ones and the ancient ones. I need not dilate upon the advantages of the one type over the other—unless I may illustrate the point by telling of one ancient inn in which I stopped, where the hole in the bathroom ceiling that accommodated the wastepipe was so large as to give excellent visibility from my bath into that above, and presumably much better from that above into mine. Incidentally, this hotel was sufficiently near Niagara Falls for me to have selected the town in which it was located as a base for a two days' stay at the falls. The idea was that I would save money, as against the Niagara hotels. I didn't—the ramshackle place in . . . . charged full Niagara rates. This, too, I judge is characteristic; the best in hotels costs no more than the worst in the same location.

This is all fairly obvious, but there is another item that isn't—until you have met it. It is only in the very largest cities, of half a million or more, that freight trains are segregated from those carrying passengers. Everywhere else, the freights run either right through the passenger station, or very close by it. The hotels are, of course, in the business section; and, except in the few cities of eccentric geography like Toledo, where the station is clear out of town, this means that hotels and trains are close neighbors. It doesn't make any difference in the real metropolis, where only passenger trains figure; but in the others it makes all the difference in the world. One of the wildest nights I ever spent was in the leading hotel—and a mighty fine hotel it was—of a prominent Ohio city of medium size, which shall be nameless. All the freight trains in the world ran through that burg between midnight and 4 A. M., and my sincere belief is that most of them stopped on my windowsill to whistle and work steam. So nowadays, I always scout about a little, on the map or on the ground or on both, to determine the relationship existing between hotels and railroads, before pitching my tent in any hotel.

Of course there are notable exceptions to the above rule. New Haven and Hartford occur to me offhand. But one must not trust too heavily in the prima facie aspect of the situation. I got excellent accommodations one summer's eve, obviously out of range of the trains. But the public square, around which all the trolleys in Indiana whirled all night long in merry whirligig, was right beneath my windows; and so far as I could judge, 99 44/100 per cent of those cars had flat wheels, while 100 per cent of them were equipped with electric horns that would turn any joy-rider green with envy.

In general, of course, if you can't avoid what looks like a noisy location, you can minimize it by asking for a room high up, on a court. The altitude can be waived at no other cost than that of fresh air; the inside location is the thing that kills the noise.

The comparison between the ancient and the modern in hotels reaches the point where one is most strongly moved toward violence in the country town of five or ten thousand inhabitants. Few such places have more than one hotel; and when it is the old-fashioned Commercial House, it is likely to be as bad as hotels can be. I will drive on almost indefinitely into the night before I will put up at such a place—but then, I am a strong driver. If one is reduced to patronizing one of these establishments, the best chance for decent accommodations will be found in the smallest village that boasts a hotel at all. I recall particularly one pleasant surprise I had in a Vermont hamlet of about six houses and a post office. Two large, clean, airy rooms for three people (with running water in one of them), plus excellent breakfasts, all for the magnificent sum of three dollars and a quarter.

The private house is a gamble. The rooms and the breakfast may be admirable, and

they may be bad without limit. The guiding principle here is to pick out a house that looks as though the renting of rooms were a regular business, and not a mere expedient for picking up a casual touring dollar now and then. Yet I once had handsome accommodation in a house of just the latter type. I found it by inquiry at the general store, which I would suggest as standard procedure. But don't inquire at any cheap-and-nasty restaurant; if you do, you will infallibly be referred to some relative of the restaurant proprietor who runs a cheap-and-nasty rooming house.

In many small cities and country towns, if the hotel is full when you apply—as is likely to be the case—the clerk will offer to get you accommodations "outside." If duly forwarned, you will realize that under this arrangement you are still the hotel's guest, and you will not protest; because you will get as good a room as is to be had—the clerk will see to that, in the interests of his employer. But don't forget that he has to make his dicker with the lady of the house to which he takes you; so when he hops off your running board and dashes up the front walk, don't dash after him until he indicates that he has transacted his business.

In many parts of the country summer resort villages, or resort inns in the open country, are fairly numerous. I have found that these are the ideal places to put up. Sometimes they will be found right along your route; I have in mind one instance, where cities of some 30,000 stand about 50 miles apart on a section of a certain transcontinental route which the average tourist hits just about at the end of a day. In one of them hotel accommodations are indifferent, in the other indescribably bad. But halfway between them, out on the mountain tops, miles from any railroad, is a perfectly gorgeous little resort village with two clean, comfortable, reasonably-priced hotels. In even more cases, one can locate such a place by turning aside a few miles from one's route—if only one knows just where to turn. I must break the cloak of anonymity that surrounds most of this hotel chatter, long enough to point to Mayville, N. Y., as a shining example of this. It is eight miles up in the hills from the main highway joining Cleveland with Buffalo—the New York-Chicago route which I have recommended. The accommodations there are so vastly superior to anything that I have ever seen elsewhere along this section of the "Yellowstone Trail" that they would be worth a detour of much more than 16 miles.

One very happy thing about these resort hotels is that a great proportion of their custom comes to them over the road—which is not the case with city hotels, even when these make a gesture of welcome toward the motor tourist.

If you are taking a transcontinental tour, or anything approaching one, there will be times when you will prefer "sleeping out" to anything that you can get in the way of indoor beds. Without carrying anything resembling a full camping equipment, you can, and should, have with you, on such a journey, the bare necessities for making yourself reasonably comfortable in these conditions. And wherever you tour, for whatever period of time, you may very profitably steal one leaf out of the camper's book. Breakfast, if you are not camping, you will get with your room; a hot, hearty meal at the end of the day you will want to buy. But for the noon repast, you will find it very advantageous to fend for yourself. Milk, butter, bread, cheese or other filling for sandwiches, fancy crackers, fruit, ice cream and soft drinks—every ingredient of a picnic lunch, in fact—can be purchased along the way, somewhere between your starting point for the day's run and noon-time. Do it that way, stopping to eat it when you feel like it and find a favorable spot.

One more point occurs to me as I read proof on the above. When you look forward to an early start next morning, make sure not only that the garage where you place your car is open at the desired hour; but equally that you get a berth from which your bus can be extricated without half an hour's shuffling about of later arrivals. If necessary, the garage man will leave your car in the street until a late hour, and put it in for you, on top of the others rather than under them.

Just another point, look over your car before starting out on the day's run. It takes but a few minutes to look over the tires, the water in the radiator, the oil in the crank case—and the gas supply. It seems needless to suggest these things, yet there are motorists who will go day after day without ever thinking of anything else but the gas tank. There is no better time of going over the car in this superficial manner than early in the morning, just before starting out on the day's run, and little things which do require attention will be attended to then and there; whereas, during the day, while on the road, those same things are apt to be neglected not only for want of immediate garage facilities but also for lack of necessary time. Remember, on an automobile tour the all-important consideration is the car itself, and it should come in for proper attention.

Growing Our Own Bananas

(Continued from page 86)

and is exceptionally fine in flavor, the preference of the Floridian for eating.

The Orinoco, sometimes called "horse banana," has the largest fruit of any variety grown in Florida, with a flavor equal to the imported, and is the tallest and most majestic, with the exception of the Giant Abyssinian, which is a magnificent ornament, but even in the tropics does not bear good fruit.

Already the plant breeder has begun to develop improved strains of the varieties suited to Florida, and they can undoubtedly be made to meet any market standard by selection and crossing.

The common yellow banana of the fruit-stand is a variety called variously the Martinique, Yellow Jamaica, Honduras, South American and Gros Michel. It has a thicker skin than the varieties being developed commercially in Florida, and is not so tender or delicately flavored, being best adapted for picking green and shipping long distances. It is grown successfully in Florida.

The red banana of the fruit-stand is Red Jamaica, well known and purchased at a premium for its superior flavor—it is also grown to a limited extent in Florida.

"The banana has languished in Florida because it did not get enough to eat," says Mr. Bolles. "It is an amazing feeder, and when fertilized and cultivated, produces bunches here in Florida that are as large as any grown in the tropics, and a tonnage per acre that exceeds tropical yield. This is due to the fact that tropical bananas, not being fertilized or cultivated, must be planted at considerable distances, whereas in Florida we plant close, 400 to as many as 600 plants to the acre. Improved Cavendish bananas have been harvested here nine months after planting, in bunches with 350 bananas, 16 "hands" or clusters, weighing 125 pounds. Florida's cool winters tend to kill or check the blights and parasites that hamper tropical banana plantations, and even threaten their extinction. With this natural advantage, and intensive cultivation, the Florida banana planters can afford to spend from $100 an acre upward yearly in fertilizers and mulch material."

In setting out a plantation, holes 2½ feet in depth and diameter are dug, filled within 10 inches of the top with manure or fertilizer and top soil, and the bulb is then set in and the hole filled to the top. Bananas can be planted any month in the year, and in a plantation fruit is maturing every month in the year, though bunches ripen faster in the spring and summer. Almost anything obtainable in the way of fertilizer is a welcome item on the banana's bill of fare—the nitrate, potash and phosphate in chemical fertilizer, the by-products of industry like packing-house tankage, cottonseed meal, fish offal and castor pomace, the manure from horse stables, cow barns, sheepfolds and poultry yards, and everything in the way of vegetable trash, from grass and soil to the leaves and stems of the banana plants themselves. Many kinds of soil are suited to this fruit, particularly Florida soil not adapted to oranges or grapefruit, but generally it thrives best on rich muck or loam, requiring abundant moisture, but also drainage for protection against drowning out in heavy rains and overflows.

To date about 3,000 acres of bananas are growing commercially in Florida, and there will be a crop to market next year through the growers' association which has been organized to deal with the infant industry's marketing problems in advance. However, Florida itself imports so many bunches of bananas from the tropics that it will be several years before markets need be sought outside the State. When that time comes, Florida will have advantages in competition with the tropics, being nearer many of the large northern and eastern consuming centers, and able to ship fruit ripened on the plant, or more nearly ripened than the bananas that come from the furthest boundaries of the Caribbean.

In fact, those who have been most active in encouraging this new industry, quote figures that are striking. An acre of bananas grown on the intensive system should bear within 12 months after planting, and records for the past 30 years show that 10 crops can be expected in 12 years. Bunches of 35 to 50 pounds are satisfactory, though larger ones can be raised. With 400 plants to the acre, each bearing a 50-pound bunch a year, and selling at five cents a pound, the gross revenue is $1000 an acre. Cost of cultivation, fertilizer and harvesting is from $250 to $300 an acre, leaving a net profit of $700 to $750—and these are by no means the highest yields for prices.

However, while the writer does not wish to dampen honest enthusiasm or cast reflections upon anybody, considerable experience with new specialty crops has taught him this:

The kind of men who first discover such possibilities must be enthusiasts as well as experimenters. The enthusiasm necessary to start an industry in the face of skepticism and discouragement is likely to be superabundant, over-optimistic. Such enthusiasm is communicative, and fires others who would rather believe rosy prospects than investigate them. Thus, there usually comes a time before the industry is strongly established when a boom develops and is followed by a setback and reconstruction on a sounder basis.

This may not be happening in Florida. The possibilities for a successful banana-growing industry there seem very good. But this industry is still under school age. Therefore, any interest in it aroused by this article must be counterbalanced with the conservative admonition, "Watch your step!"

Telephoning Our Press Photographs

(Continued from page 87)

potential, these electrons will be drawn to it and a current will flow in the connected circuit. The number of electrons varies directly with the intensity of the light, thereby making the strength of the current follow accurately any variation taking place in the intensity of the light beam. Because the resulting currents are, in many cases, too small to operate reproducing apparatus, it is necessary to amplify them exactly as is done to feeble speech currents in long-distance telephone lines or in radio.

The virtues of this method of image transmission lie not only in the quality of the photographs reproduced but also in the fact that the method is fast and can be adapted to any standard telephone line without alterations. Tests have shown that it may also be adapted to radio whenever conditions of static and other forms of interference permit. This notable achievement is the outgrowth of the concerted effort of the engineers of the Bell System laboratories and represents the close knitting together of many researches extending back over several years. The future development of this business will depend entirely on the demand. It is easy to conceive of many applications of this device not only in the transmission of actual photographs for news purposes but also for the transmission of engineering drawings and signatures to business documents, whenever delay would involve loss of valuable time. It has also been suggested that the rapid transmission of pictures of fugitives and criminals would frequently assist the ends of justice.

The transmission of photographs over wires has been the subject of much inventive talent during the past ten years or more. Until the appearance of the present system of image transmission, the most promising system has been that of a Frenchman, Edouard Belin, which has been demonstrated in this country. Back in 1921 Belin gave a demonstration under the auspices of the New York *World* and the St. Louis *Post-Dispatch*, in which photographs were transmitted over telephone lines between New York and St. Louis. An account of this demonstration, as well as the various features of the Belin system, will be found in the files of this journal. Mr. Lescarboura, of our editorial staff, took an active part in the demonstration of the Belin system. This French system makes use of delicate apparatus, including a string galvanometer, and it is certainly more at home in the laboratory than in the hands of the workaday world. Therefore, it is but fair to state that the present Bell system appears to be more highly developed than the Belin system, not only in the results obtained but in the relative simplicity of the apparatus.

A Landing-Field That Goes to Sea

(Continued from page 94)

assume a formation and get nearly out of sight.

As they return to the ship one of them flies close to see the signal. The executive officer signals for the whistle to blow. The vapor from the blast of the whistle has been found to be the best visible signal for the direction of the wind. Several blasts are used to determine the direction of the ship relative to the wind. If the ship is not heading into the wind it is warped around so that it will be. When this is done the executive officer orders "Rig the deck." Many men run from the nets onto the deck to rig the arresting gear (the details of which are confidential) for the landing operation. The executive officer on one side of the deck and the senior flight officer on the other side indicate by arm signals whether or not the pilot is approaching the ship correctly and is at the proper height. If the pilot finds he is too low he merely circles the ship again; for "safety first" is paramount in this work. The second time the approach is made (be it known, however, that the landing is nearly always made in the first approach), the plane glides gracefully to the deck, slows down and is held there with the strong grip of the arresting gear with a remarkable short travel of the plane. The pilot jumps out. This plane is run forward and down by the elevator to the main deck. The second plane and then the third land just as gracefully. The whole operation has been completed within the short space of 20 minutes.

As soon as all planes are landed, up goes the port smokestack, the masts are raised, the jackstaff and flagstaff stepped, anemometer masts raised, life nets brought up, and boats recalled. The ship is now a vessel ready for cruising.

Our Abrams Investigation—XI

(Continued from page 96)

sibility in a small percentage of cases; but electronists get many cases which are by no means grave but which require relief. We have had case after case brought to our attention where a patient, spending six months or a year with E. R. A. treatments at a considerable cost to the average family pocketbook, has had absolutely no results—save encouraging "diagnoses." Then, on going to an orthodox practitioner, that same patient has been brought back to health—a reversal of the E. R. A. testimonial. One of the most striking cases we have record of is that of a lady who doctored for the better part of a year with an electronic worker rather than undergo an operation for cancer. Finally, the electronist turned her out as "cleared up," but in less than a month that lady had to undergo an appalling cancer operation which barely saved her life. Had she been operated upon in the first place, she would not have permitted the cancer to gain the ground which it did, impairing her health for all time despite the eleventh-hour operation. And there must be many more cases of the same general nature of which we have no present knowledge.

No, testimonials mean nothing. It is quite evident that E. R. A. have hand-picked the letters which they have brought to our attention and to the attention of the public at large. Were we compelled to do so, we could match one case of rank E. R. A. failure for every six E. R. A. testimonials. If it were not for the fact that in the usual E. R. A. failure the patient says nothing about his case, there might actually be an even break between testimonials and failures.

There are so many elements which enter into even a genuine cure that evidence of this kind means little. No one realizes this better than a skilled doctor. He will tell you of cases which have baffled medical attention for years, and then suddenly cleared up for no apparent reason. He will tell you of such serious diseases as pneumonia, which have taken a sudden upward turn after the medical profession had given up hope. He will tell you that every ailment has a psychological as well as a physical side, and that the proportions of these sides vary in every case. A new "cure," properly presented to the patient—"sold" to him through wonderful testimonials and the proper atmosphere of awe—will work wonders in many cases where the psychological component is great. Even without the slightest scientific value a "cure" may be responsible for astonishing results. The "gaspipe" therapy of a decade ago had a wonderful collection of testimonials, alleging all kinds of cures despite the fact that the sole bases for treatment consisted of hooking up the patient with a piece of brass tubing filled with pink plaster of paris. Here again was a mysterious form of energy which was said to have remarkable curative properties.

The electric belts of two decades ago met with great success, financially and otherwise, until the fallacy of the idea permeated the public mind. Electric insoles, guaranteed to relieve sore feet of all kinds and consisting of a zinc insole for one shoe and a copper one for the other, have had their day. Indeed, ever since one Elisha Perkins, a Yale graduate, invented his metallic tractors—an assembly of dissimilar metals about the thickness of a lead-pencil and about four or five inches long, supposed to apply voltaic energy to any part of the body stroked with them—there has been no end to electrical or near-electrical and magnetic devices introduced as new and remarkable "cures" and bolstered by testimonials.

Perkins's success was quite as spectacular as that of E. R. A., considering the general conditions of a century ago. He was successful in enlisting the greatest doctors in his work. His writings were translated into several languages, and his fame spread far and wide. A Perkinean institution was founded in Great Britain, through public subscriptions; indeed, this institution received a better endowment than any hospital in London possessed at that time. Over 1,500,000 Perkins cures were reported early in the nineteenth century, when the Perkins tractors were being widely used by doctors and laymen alike.

Finally, a canny English doctor, suspecting the Perkins technique to be nothing more than a mind cure, used a pair of old tobacco pipes under the guise of tractors, and cured patients of their ailments. Other English physicians followed suit and demonstrated the utter nonsense of the Perkins tractors by making imitation tractors out of wood but coloring them exactly like the original, genuine tractors, and then using them in the genuine Perkins fashion. These doctors proceeded to effect a series of striking cures. When once these facts became known—when the public once became aware that the Perkins results could be obtained with mere pieces of wood—the tractors lost their curatic properties. By 1810 the Perkins method was utterly discredited and the doctors and the public alike had gone back to more rational if less spectacular medical practice, ready for the next "cure" to come along.

We may be pardoned for comparing the E. R. A. technique with that of Perkins, even though the former is far more elaborate than the latter of a century ago. There is a striking parallel, up to a certain point. Dr. Abrams made the claim that the basis of life was not the cell but the electron, thus setting up a new theory in medicine. He then went on to outline how the electronic balance within the body made for good health or for disease. He worked out a method of diagnosing by means of the electronic energy, employing the human reflexes as a detector of this energy, because, according to his claims, there was no instrument available for detecting this energy. Thus it became impossible for the physicist to follow him and check up on the Abrams claims of an electronic flow passing through a series of tuning resistances. Dr. Abrams did not speak the physicist's language. On the other hand, Dr. Abrams, because of his new concepts, which were quite contrary to established medical knowledge, did not speak the medical man's language. In this manner he enjoyed a monopoly in his newly-created field, for whatever it might be worth.

Now, Dr. Abrams, by means of his self-created theories and technique, was in a position to diagnose patients and tell them what he found. In some cases his findings checked up with those of orthodox diagnosis; in others they did not. When the check-up was perfect, Dr. Abrams announced the fact as proving not so much the efficacy of his system, but that of orthodox methods—for a change. When the check-up failed to materialize, then Dr. Abrams stated in so many words that his findings were correct while those of orthodox diagnosis were incorrect and worthless. Dr. Abrams stated that his method was so delicate and so precise that he was in a position to detect diseased conditions in their very incipiency, long before orthodox methods could detect or even suspect such conditions. Here again Dr. Abrams was in a field by himself, provided always that his word was to be accepted as final. No one could check up his work but himself.

Having told a patient what ailed him, according to the electronic diagnosis, the next

step was the treatment. Here Abrams worked out a machine known as the oscilloclast, consisting of a current interrupter connected with the usual lighting circuit, and said to deliver a periodic application of electromotive force to any part of the human body. The usual periodicity for good effects is in the neighborhood of 200 per minute. A description of the interrupter, which is of the electro-magnetic type with a pendulum connected to the rocking armature, appears in Patent No. 1,445,951 issued to S. O. Hoffman. This patent appears to be the only patent ever issued on the Abrams technique and its apparatus, and it covers merely the circuit-controlling device.

The oscilloclast is the foundation of the Abrams treatment. Go to any E. R. A. clinic or practitioner and you will find one of these machines ticking away, as its rocker armature swings back and forth. One oscilloclast takes care of several patients at a time. Although the oscilloclast makes and breaks a circuit about 200 times per minute, it is said to deliver high-frequency waves which have the power of shattering destructive electronic rates within the patient. Since all patients are not alike, it becomes necessary to adjust the energy said to come from the oscilloclast, and this is done by resistance boxes. One resistance box is placed in the oscilloclast output circuit for each patient; generally, this box is placed in the booth in which the patient lies down while receiving his or her treatment, and is provided with a little lamp that blinks in step with the ticking oscilloclast. Practically all patients agree that no sensation is felt during the treatment, which makes somewhat for the popularity of this treatment as compared to the sometimes uncomfortable and inconvenient orthodox treatment, especially operations, and the bad-tasting medicines.

We have studied the oscilloclast as a plain problem in physics. The first thing to be determined was: Does the oscilloclast give off energy which may or may not have therapeutic value, or is it simply an amulet which brings about cures merely through its psychological effect?

It is our opinion, based on our own personal observations and not influenced by other investigators who have already passed adverse judgment on it, that the oscilloclast is nothing more than an electric buzzer. You might just as well tie a door-bell around your neck and expect to be cured as to rely upon this instrument. It does not deliver energy in the usual sense of the word. It is a sheer waste of time to try to detect the energy coming from the oscilloclast, for the wiring plainly indicates that no energy can come from it. Then, to settle all possible disputes, we have merely to take the statement of its inventor, Dr. Abrams, appearing on page 46 of the June, 1923, issue of *Physico-Clinical Medicine:* "Only one leg of the current is used. There is no current in an oscilloclast. You have a series of vibrations. You have what is known as a high-frequency or static charge." And further on: "The current passing from oscilloclast through the patient's body is easily detected with my oscilloclastophone." The usual Abrams inconsistency!

But, argue the E. R. A. practitioners, there may be a very slight electrical energy coming from the oscilloclast, which is sufficient to combat the destructive electronic waves in the patient. Well, let us see just how orthodox electrotherapy feels about this matter. "The usual pathological dose of current is from 2 to 10 milliamperes. Apparatus pretending to cure, and incapable of furnishing such currents, is worthless," states Silvanus Thompson in his "Electricity and Magnetism." Strange as it may seem, after Dr. Abrams pronounced in cold black and white that no electrical energy came from the oscilloclast, we find J. E. Hallberg of the Burnett-Timken Research Laboratories stating that "with the most delicate galvanometer ever built" he has found the oscilloclast electrode to deliver 8/1,000,000 of a volt and 1/100,000,000 of an ampere!

Six months ago we called at the Burnett-Timken Research Laboratories at Alpine, N. J., and spent an entire day with Mr. Hallberg and Dr. J. Clausson Burnett. Dr. Burnett, who enjoys considerable wealth, is intensely interested in new medical ideas. In fact, he has stated to the daily press that he is interested solely in aiding the masses toward better health. To that end he has constructed a vast non-magnetic research laboratory on the brink of the Palisades, overlooking the Hudson River, for the purpose of carrying on medical research, especially of an electrical and mechanical nature. However, it is but fair to state that Dr. Burnett has been closely identified with

E. R. A. activities, and many of his past utterances have indicated a strong bias in favor of the late Dr. Abrams and his teachings. Dr. Burnett could hardly be considered a disinterested party at the time we met him. Furthermore, Dr. Burnett does not appear to be interested in regular medicine. He is seeking some new therapy which will work wonders where present orthodox methods fail.

We found Mr. Hallberg, who is the research man for Dr. Burnett, engaged in demonstrating that the oscilloclast gives off electrical energy. A wonderful array of electrical apparatus was available for the purpose. Two demonstrations were staged for our benefit, one being in the nature of audible indications from a radio loud-speaker that the oscilloclast electrode was delivering something, and the other in the recording of energy by a super-sensitive galvanometer. The first test was based on an absolute fallacy. Mr. Hallberg was using one of Dr. Abrams' own ideas for demonstrating the energy given off by the oscilloclast, namely, the chirping of a loud-speaker in step with the oscilloclast tick-tock. All Mr. Hallberg was getting in this case was merely the body capacity effect of the electrode connected with the oscilloclast, which was sufficient to upset the oscillating-circuit receiver which he was using. For that matter, the passing of one's hand in the vicinity of the oscillating circuit would do the same thing. In fact, we disconnected the oscilloclast altogether, and simply touched the wire from the electrode with another piece of wire laid on the table, obtaining the same results from the loud-speaker. It was plain that the oscilloclast was delivering nothing, so far as this demonstration went. Both Mr. Hallberg and Dr. Burnett admitted the fallacy of their demonstration.

The galvanometer demonstration was at least based on sound common sense, but hardly impressive. As the oscilloclast ticked away, a slight capacity charge was slowly accumulated in the patient's body and could be detected on the galvanometer. When the patient, who was standing on an insulated mat, touched the bare wall the accumulated charge was dissipated, indicating a slight static charge followed by a discharge.

What does this prove? Simply that one can demonstrate almost anything if one is permitted to go to the utmost limits as regards terms. Thus we could state that a wall is a sieve. That would bring forth ridicule. Then we could set out to get the most powerful microscope available and prove that the wall consisted of bits of matter with big spaces between. We could apply tremendous hydraulic pressure on that wall and force water through. Water has been forced under high pressure through no less dense a substance than gold—but you would dispute the statement that gold is "porous." There aren't many absolute zeros in this world; most of the things we call zero are in fact merely infinitesimals. If we lose sight of the distinction between an infinitesimal and a finite quantity, we can prove almost anything.

A favorite E. R. A. demonstration of the oscilloclast is to actuate a radio receiving set—to pick up the make-and-break of the oscilloclast at a distance. There is nothing startling in that demonstration. Any radio set of today, with two stages of audio-frequency amplification, will detect the ringing of a door-bell in the same house. It will respond to a faulty vacuum cleaner motor a block away. If a storage-battery recharger of the vibrating type is in operation even a quarter-mile distant, the sensitive receiving set will detect it. Why should that same set, therefore, not respond to the clicking make-and-break of the oscilloclast? And what has that to do with proving the therapeutic value of the oscilloclast, unless we are to understand that buzzers, bells, faulty vacuum cleaners, storage-battery rechargers and other commonplace devices give forth curative energy?

Let us not forget the real object of the oscilloclast. According to the teachings of Abrams, the oscilloclast can be tuned to give various "rates" or waves which will smash up the destructive "rates" or waves within the patient. The E. R. A. practitioner makes his diagnosis and tells us that we have so many ohms of congenital syphilis, so many of carcinoma, so many of tuberculosis and so on. Occasionally his findings check up with those of an orthodox practitioner, but generally they do not. When they do, that proves the skill of the orthodox practitioner; when they do not, that simply means that the electronic diagnosis is far more delicate and positive, so we are assured. Nobody but the E. R. A. practitioner can tell you have those precise ohmages. You must take his word for it. Then he begins treating you with the oscilloclast, occasionally making further electronic blood tests and telling you that your ohmages are being reduced. Again you must take his word for it. Finally, he tells you that your ohmages have been cleared up. Electronically speaking, you are cured; but it does not necessarily follow that you are feeling any better than in the beginning. After all, electronically speaking, that is only a detail. The original idea was to clear up the ohmages, and that has been accomplished.

No, this committee cannot subscribe to the Abrams claims as regards the curative value of the oscilloclast. Viewed from the physical side, the oscilloclast fails to impress us. And viewed from the medical side, we are unimpressed by the E. R. A. testimonials, glowing as they are.

Volcanoes—Or Cosmic Shell-Holes?—II

(*Continued from page 102*)

iron meteorites can be likened to it) fired from a shot gun into a yielding target at very close range, or a bullet from a high powered rifle, may object that the lunar craters are too round to have been produced in any such way, since the impacting body in all cases must have approached the moon vertically, which was manifestly impossible. The Arizona crater, the impact origin of which is now proved, is just as round as the lunar craters; and yet we have the strongest sort of reasons to believe that the meteoric mass which made it approached the earth at probably the low angle of 45 degrees from the vertical and plowed its way through some 2600 feet of rock, holding to its line of flight until it came to rest under the southern wall, which for 2700 feet in length it has uplifted and arched in a significant way. Dr. Merrill tells me that all meteorites which have been known to fall have probably approached the earth at an angle and never vertically. Also one who has not fired at short range rifle bullets, especially from a high powered rifle, and charges of shot into stiffish mud (to which hard, compact rock can be compared when the speed and weight of the impacting mass is considered), even when holding the piece at an angle as low as 45 degrees from the vertical, does not know that the resultant crater is almost round and that the splashing distribution of the ejected material is exactly similar to these effects in the cases of the lunar craters and the Arizona crater. I have made a great number of such experiments. The similarity between the miniature bullet-made craters and the great craters I am discussing, including the Arizona crater, is more than coincidence. It cannot, in my opinion, mean anything else than similarity of origin. Even in the lunar craters one in many instances can tell from what direction the impacting mass approached, for the simple reason that more ejected material is observed to be on the side of the crater opposite to that from which the mass approached, just as in the case of the Meteor Crater of Arizona. In some cases the rim is higher than on the side from which the impacting mass approached. In short, if one will make a careful study *on the ground* of the Arizona crater and then study the lunar craters as carefully as I have done, he cannot escape the conclusion, there being so many exactly similar features, that they have had a similar origin. Some distinguished astronomers, for example, Moulton (Introduction to Astronomy, p. 214), seem to have been under the erroneous impression that the impacting mass in order to make a round crater must of necessity have fallen straight toward the moon's center. Such experimentation with a high powered rifle as I have mentioned would soon convince them of their error. I have been told by those who have seen both and therefore were able to compare them, that the holes in the earth made by unexploded shells ("duds") during the late war were very similar in appearance to the Arizona crater, although the shells fell of course at an angle and not vertically.

The fact that it is easy to pick out the lunar craters which are younger than others and others which are younger still is very important. It is easy to find on a photograph a vast number of craters which have been almost covered and obliterated by the material thrown out of a neighboring crater or craters. To my mind the seas show this effect very well, obliterating, as they seem to have done, or filling pre-existing craters with molten material. We note especially—I repeat this purposely—that some craters and the areas surrounding them appear to

be much brighter than others. I am strongly of the opinion that this is an effect which is best explained by the reflection of sunlight from the white or very light colored pulverized rock flour which has not yet had time to be covered with cosmic dust or the ejectamenta from neighboring craters. Certainly the youngest craters, judged by other signs, have this characteristic. In not one of them do we find a smaller crater. It is an effect which is not observable in the manifestly older craters.

It is easy to believe that we see the records of impacts when the lunar surface varied in hardness or in plasticity all the way from hard rock to molten rock. The "mountains" surrounding Mare Imbrium, for example, are just what might have been expected to result from the addition of a tremendous mass of foreign material, a great many miles in diameter, or possibly—as has been suggested to me—several of these great, compact clusters of meteors striking more or less centrally at the same moment. As previously stated, waves of molten rock would flow outwardly and radiantly with great force from the point of impact and the semi-liquid or liquid material would pile up around the edges in mountain-like masses, overrunning or filling previously existing craters, but the "rim," so to speak, or short line would be more or less circular. Huge masses of melted rock would go quite a distance beyond it, but always radially. The radiant, splash-like effects extending beyond the more or less circular edges of the so-called seas, are very impressive and certainly are not suggestive of volcanic action as we know it. Moreover, when one considers the lunar surface as a whole, in view of the above explanations of its various features, he is forced to conclude, as I think, that it is just such a surface as would be the result of innumerable impacts of extralunar matter but not at all the kind of surface which would be produced by volcanic activity as we understand it. There is nothing on it which is not explainable on the impact theory but there is a great deal which cannot be explained on the volcanic theory.

To conclude, it is my belief that the history of the moon since it contracted possibly into a liquid mass (although it may never have been wholly liquid) has been somewhat as follows:

First, that the surface became solid on cooling and received innumerable additions of extralunar material which made typical lunar craters, often showing the central hill or nipple like protuberance.

Second, that it received some very large additions which struck with force enough to melt or much more likely to break through the crust with the result that molten matter welled up from below and flowed more or less radially over large areas of the surface, often with tidal wave violence, forming the roughly circular seas or plains and the mountains surrounding them. Or, as suggested above, possibly the terrific force of the impact was sufficient, because of the heat produced and by relief of pressure, to liquefy the already hot but more deeply seated rock and cause it to erupt and flow radially outward with great violence.

Third, that the surfaces of these areas soon solidified upon exposure to the cold of space and later received additions of extralunar matter. Some of these impacts possibly occurred before a thick, strong crust was formed or were of sufficient violence to break through the crust. The result of this would be that the liquid material beneath would rise to the level of the surrounding sea or plain and a rim but no permanent central hill would be formed. These should not be confused with craters older than the seas which evidently have been partly but not wholly filled with molten matter.

Fourth, that these seas or plains received still later additions when their surfaces and the crust beneath were much more solid and resistant, with the result that typical craters with the central hill and splash-like effects were produced, but no general fusion.

I refer anyone who is interested to my previous papers on the Meteor Crater of Arizona and especially to the one which was read before the National Academy of Sciences at its Autumn meeting at Princeton in 1909, and also Professor Worthington's Study of Splashes, from which the two smaller views on page 102 were borrowed. I have written this paper largely for the purpose of stimulating an interest in these remarkable features of the lunar surface from the point of view which I have set forth, namely, that very probably they are one and all the effects of impact and quite possibly we are afforded by them a wonderful oppor-

tunity to see how our solar system has been built up. There should also be read in connection with this argument a most interesting paper by Elihu Thomson entitled "The Fall of a Meteorite," proceedings of the American Academy of Arts and Science, Vol. XLVII., No. 19, March, 1912, in which he expresses his belief in the impact theory of origin of the lunar craters.

Softwood Forests and Timber Supply

ALTHOUGH one fifth of the earth's surface is still covered with forests and there are over four acres of woodland for every man, woman and child on the globe, yet Raphael Zon and William N. Sparhawk, economists of the U. S. Forest Service, in a survey of the forest resources of the world just published, point out that the coniferous "softwood" forests of the northern hemisphere hold the fate of a world-timber supply problem in their depths.

Whether these coniferous forests that now supply more than three-fourths of the lumber of the world will be able to meet the demands of the next two or three generations depends upon what steps are taken in the next few years to put them on a permanently productive basis.

Only 80 per cent of the pine, spruce and other softwood timber cut is being replaced by growth. Softwoods, because of their light weight and ease of working are particularly adapted for construction use and a multitude of industrial uses for which the harder, heavier woods are not so suitable.

The best of the hardwoods of the temperate zone, including oaks, maple, ash, walnut, birch, beech and other kinds, are also being rapidly depleted. But the forest economists find that in the tropics there are vast reserves of hardwoods which can be substituted for any of those now used, and that the extreme rapidity of tree growth in the tropics makes it exceedingly unlikely that these supplies will be inadequate for centuries, if ever.

Fifty-six billion cubic feet of wood a year is used by the world, according to their estimates. Almost half, or 26 billion feet, is saw-timber, and nearly 30 billion feet is firewood. The firewood is equivalent in heating value to approximately one-fifth of the world's consumption of coal.

The Wars of Ants

(Continued from page 106)

weaker than their own, they do not attack, or they may engage a foe many times stronger; this indicates at least that they cannot estimate their own nor their enemy's strength and numbers. For the most part the greatest desire is to fight.

Though possessed of the finest instincts with regard to their home duties, ants have not further visible cooperative methods, even in warfare, other than that some few remain on guard at the nest; the greater number go out to battle whether defensively or on a raid. It may be said that some direct aggression is always the beginning. The fighting forces of the two tribes do not meet half way as though on a challenge, nor is the fighting itself any more than might be expected of a mob. It is every man for himself—every Amazon rather, for only the worker ants are engaged and they are all females; all spinsters, in fact, though possessed of the spirit of pugilists when they forsake the ways of peace.

But the foray seems to be in concert, perhaps in response to some signal. When one hunting ant finds a desirable food supply it returns with a portion thereof and from this hint others of the colony, like hounds on a rabbit, back-track the discoverer and each carries its share, or often more than that, to the nest. If in any way the finder is frightened off so that it does not return with any of the desired material the others by their keen sense of smell know that it has made a find and out they go to it.

But can anything of this kind occur when one ranging ant discovers an enemy colony? Or is it only after the ranger has been attacked and has escaped that the nature of its discovery is known? It is safe to assert that ants have no actual language, but they can communicate impressions by their sense of smell, though this power has been grossly exaggerated by those who love best to tell wonderful stories. The fact remains, however, that the ants which first discover the other colony are the aggressors and, as though with one accord, they start out to destroy the enemy and to capture its nest and young.

The most common battles between ants of the many kinds, or at least the fights most often witnessed by human eyes, are the terrific engagements of the big blacks and the big reds of about the same size, the latter really dark brown in color, with the legs and under parts of the body of a dull, rufous tint.

The ants fighting in defense of their nests are soon also aggressors, though the battle is at first waged in the space around the nest attacked, the besiegers arriving *en masse* near the entrances. The valor of the defenders is such as to soon widen the contest, covering all the broad area between both colonies. There is no such thing as military movements; no plans nor stratagem. Each warrior engages the first of the enemy he meets, whether one or half a dozen are against him and only the death of those outnumbered settles these tilts. This also decides the general victory or defeat. When those of one side have all been killed off, or at least not enough of them are left to continue the opposition, the victors, whether these are the original aggressors or the defenders, sweep on into the now defenseless nest and having quickly disposed of the home guard and the queens, the bodies of which are carried out, they loot at will, carrying away the larvæ and cocoons to their own nest where they are stored until used as food.

The individual combats, when but two ants are opposed, are often long drawn out, neither insect being able to injure the other. One may hold its opponent's leg in the vise-like grip of the powerful jaws and perhaps have its own leg or antenna seized. Then follows a tugging and twisting and circling about to hold on and to get free. The death of one of these scrappers usually comes when another, or several of the enemy arrive. Or one antagonist may succeed in getting a fatal hold, sometimes severing the head or abdomen of its foe.

These feudal wars will go on as long as ants roam the forests of grass blades, for with all the admirable gentleness that these insects have developed toward members of their own kind, resulting in social amity that surpasses anything man has ever attained, the busy little creatures have not learned mercy, nor to show less malevolence toward tribes of related kinds.

Taking the Period Out of the Automobile Engine

(Continued from page 107)

membered that while the use of the heavier crankshaft shortens the amplitude of the vibration and raises the critical point, nevertheless the reactions against torsional stresses which are large enough to cause deflection in the shaft are still high enough to cause severe stresses. In fact, these stresses which are of a momentary nature are so high that the entire front end drive has to be designed to take a far higher horsepower than that required merely to take care of the duty of driving the camshaft and generator-shaft. In other words, if the angular velocity of the crankshaft were at all times uniform a far lighter front end chain could be used.

When the automatic spring take-up was inserted in the front-end drive of the first experimental models, a decided smoothing out of the entire engine was noted. This developed into something more than merely silencing the chain because it was operating at the proper tension. Engine periods which had formerly existed were found to have disappeared and consequently noises that were considered to be far removed from and without relation to the front-end drive also disappeared.

To make a long story short, the spring take-up has been found to work out as an excellent vibration damper. As the angular velocity of the crankshaft changes under the impulses of the pistons or due to the varying inertia forces, causing alternating stresses to be imparted to the front-end chain, the tension coil spring works back and forth, decreasing and increasing its tension. The natural period of a coil spring depends on its tension. As the tension increases the pitch of the spring tune rises and as the tension decreases it lowers. As the tension on this spring is continually varying to meet the changing impulses from the crankshaft the period of the spring is likewise varying and it is impossible for the crankshaft to tune in with the spring or consequently with the chain drive and the camshaft which it controls. In the case of a solid gear drive, or a chain drive without the elastic medium, an engine may have striking periodic vibrations in which crankshafts, timing drive and driven units chime in perfectly with unpleasant effects.

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